

HCM2010

HIGHWAY CAPACITY MANUAL



CHAPTER 9 GLOSSARY AND SYMBOLS



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HCM2010

HIGHWAY CAPACITY MANUAL

The HCM 2010 significantly enhances how engineers and planners assess the traffic and environmental effects of highway projects by

- Providing an integrated multimodal approach to the analysis and evaluation of urban streets from the points of view of automobile drivers, transit passengers, bicyclists, and pedestrians;
- Addressing the proper application of microsimulation analysis and the evaluation of the results;
- Examining active traffic management in relation to demand and capacity; and
- Exploring specific tools and generalized service volume tables to assist planners in quickly sizing future facilities.



The HCM 2010 consists of four volumes:

Volume 1: Concepts;
Volume 2: Uninterrupted Flow;
Volume 3: Interrupted Flow; and
Volume 4: Applications Guide (electronic only).

The four-volume format provides information at several levels of detail, to help users more easily apply and understand the concepts, methodologies, and potential applications.

Volumes 1, 2, and 3 are issued as a boxed set. Volume 4 is electronic only, accessible to registered HCM users via the Internet, and includes four types of content: supplemental chapters on methodological details and emerging issues; interpretations, clarifications, and corrections; comprehensive case studies; and a technical reference library.

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1. GLOSSARY

Chapter 9, Glossary and Symbols, defines the terms used in the *Highway Capacity Manual* (HCM) and presents the symbols and abbreviations used in the manual. Highway transportation terminology has evolved over time to create multiple definitions, and the confusion has been compounded by technical jargon. The definitions, abbreviations, and symbols presented here are intended to establish a consistent terminology for use in the HCM. It is recognized that other definitions and usage could exist.

A **Acceleration lane** – A paved noncontinuous lane, including tapered areas, allowing vehicles to accelerate when they enter the through-traffic lane of the roadway.

Acceleration/deceleration delay – Delay experienced by vehicles slowing from and subsequently returning to their running speed.

Access point – An intersection, driveway, or opening on either side of a roadway.

Access-point density – The total number of access points on both sides of the roadway, divided by the length of the segment.

Accessibility – The percentage of the populace able to complete a selected trip within a specified time.

Accuracy – The degree of an estimate's agreement with a standard or true value.

Active passings – The number of other path users traveling in the same direction as an average bicyclist (i.e., a bicyclist traveling at the average speed of all bicycles) who are passed by that bicyclist.

Active priority – A form of traffic signal priority that adjusts signal timing in reaction to the arrival of a bus.

Active traffic management (ATM) – The dynamic and continuous monitoring and control of traffic operations on a facility to improve its performance.

Actuated control – Consists of a defined phase sequence in which the presentation of each phase is dependent on whether the phase is on recall or the associated traffic movement has submitted a call for service through a detector.

Adjustment – An additive or subtractive quantity that adjusts a parameter for a base condition to represent a prevailing condition.

Adjustment factor – A factor that adjusts a parameter for a base condition to represent a prevailing condition.

Aggregate delay – The summation of delays for multiple lanes or lane groups, usually aggregated for an approach, an intersection, or an arterial route.

Algorithm – A set of rules for solving a problem in a finite number of steps.

All-way STOP-controlled (AWSC) intersection – An intersection with STOP signs on all approaches. The driver's decision to proceed is based on a consensus of right-of-way governed by the traffic conditions of the other approaches and the rules of the road (e.g., the driver on the right has the right-of-way if two vehicles arrive simultaneously).

Alternative tool – An analysis procedure outside of the HCM that may be used to compute measures of transportation system performance for analysis and decision support.

Analysis hour – A single hour for which a capacity analysis is performed on a system element.

Analysis period – A single time period (for example, the peak 15 min of the peak hour) during which a capacity analysis is performed on a system element.

Analytical model – A model based on traffic flow theory, combined with the use of field measures of driver behavior, resulting in an analytic formulation of the relationship between the field measures and performance measures such as capacity and delay.

Annual average daily traffic (AADT) – The total volume of traffic passing a point or segment of a highway facility in both directions for 1 year divided by the number of days in the year.

VOLUME 1: CONCEPTS

1. HCM User's Guide
2. Applications
3. Modal Characteristics
4. Traffic Flow and Capacity Concepts
5. Quality and Level-of-Service Concepts
6. HCM and Alternative Analysis Tools
7. Interpreting HCM and Alternative Tool Results
8. HCM Primer

9. Glossary and Symbols

Approach – A set of lanes at an intersection that accommodates all left-turn, through, and right-turn movements from a given direction.

Approach delay – The control delay for a given approach.

Approach grade – The average grade along the approach, as measured from the stop line to a point 100 ft upstream of the stop line along a line parallel to the direction of travel. An uphill condition has a positive grade, and a downhill condition has a negative grade.

Area – An interconnected set of transportation facilities serving movements within a specified geographic space, as well as movements to and from adjoining areas.

Area type – A description of the environment in which a system element is located.

Arrival rate – The mean of the statistical distribution of vehicles arriving at a point or uniform segment of a lane or roadway.

Arrival type – Six assigned categories for the quality of progression for a given approach to a signalized intersection.

Arterial street – A street interrupted by traffic control devices (e.g., signals, STOP signs, or YIELD signs) that primarily serves through traffic and that secondarily provides access to abutting properties. See also *urban street*.

Automobile mode – A travel mode that includes all motor vehicle traffic using a roadway except transit buses. It includes such vehicles as trucks, recreational vehicles, motorcycles, and tour buses.

Auxiliary lane – See *freeway auxiliary lane*.

Available time-space – The product of available time and available space for pedestrian circulation on a crosswalk at a signalized intersection.

Average bus stop spacing – The average distance between bus stops along a street.

Average grade – The total rise from the beginning of the composite grade to the point of interest, divided by the length of the grade (to the point of interest).

Average running speed – The length of a segment divided by the average running time of vehicles that traverse the segment.

Average spot speed – See *time mean speed*.

Average travel speed – The length of the highway segment divided by the average travel time of all vehicles traversing the segment, including all stopped delay times. Equal to *space mean speed*.

Back of queue – The maximum backward extent of queued vehicles during a typical cycle, as measured from the stop line to the last queued vehicle.

Barrier – 1. A separation of intersecting movements in distinct rings to prevent operating conflicting phases at the same time. 2. A physical object or pavement marking designed to prevent vehicles from entering or departing a section of roadway.

Barrier pair – A pair of phases within the same ring and barrier that cannot be displayed concurrently.

Base conditions – A set of specified standard conditions (e.g., good weather, good and dry pavement conditions, familiar users, no impediments to traffic flow) that must be adjusted to account for prevailing conditions that do not match.

Base length – The distance between the points in a weaving segment where the edges of the travel lanes of the merging and diverging roadways converge.

Base saturation flow rate – The saturation flow rate under base conditions.

Baseline uniform delay – The average uniform delay when there is no initial queue.

Basic freeway segment – A length of freeway facility whose undersaturated operations are unaffected by weaving, diverging, or merging.

Bicycle – A vehicle with two wheels tandem, propelled by human power, and usually ridden by one person.

Bicycle facility – A road, path, or way specifically designated for bicycle travel, whether exclusively or with other vehicles or pedestrians.

Bicycle lane – A portion of a roadway designated by striping, signing, and pavement markings for the preferential or exclusive use of bicycles.

Bicycle mode – A travel mode under which a nonmotorized bicycle is used on a roadway or pathway.

Bicycle path – A bikeway physically separated from motorized traffic by an open space or barrier, either within the highway right-of-way or within an independent right-of-way.

Bicycle speed – The riding speed of bicycles, in miles per hour or feet per second.

Bicycle track – A one-way bicycle facility separated from both motor vehicle traffic and the sidewalk by low curbs.

Body ellipse – The practical minimum area for standing pedestrians.

Bottleneck – A system element on which demand exceeds capacity.

Boundary intersection – An intersection defining the endpoint of an urban street segment.

Breakdown – The transition from noncongested to congested conditions typically observed as a speed drop accompanied by queue formation.

Breakdown flow – The flow at which operations transition from noncongested to congested.

Buffer width – The distance between the outside edge of the paved roadway (or face of curb, if present) and the near edge of the sidewalk.

Bus – A self-propelled, rubber-tired road vehicle designed to carry a substantial number of passengers (at least 16) and commonly operated on streets and highways.

Bus lane – A highway or street lane reserved primarily for buses during specified periods. It may be used by other traffic under certain circumstances, such as making a right or left turn, or by taxis, motorcycles, or carpools that meet the requirements of the jurisdiction's traffic laws.

Bus mode – A transit mode operated by rubber-tired vehicles that follow fixed routes and schedules along roadways.

Bus shelter – A structure with a roof and (typically) three enclosed sides that protects waiting transit passengers from wind, rain, and sun.

Bus stop – A designated area along a street where one or more buses can simultaneously stop to load and unload passengers. It can be on-line (buses stop wholly or partially in the travel lane) or off-line (buses stop out of the travel lane).

Busway – A right-of-way restricted to buses by a physical separation from other traffic lanes.

Bypass lane – A lane provided at a roundabout that allows a particular traffic movement to avoid using the circulatory roadway.

Calibration – The process by which the analyst modifies model parameters so that the model estimates best reproduce field-measured local traffic conditions.

Call – A registration of a demand for right-of-way by vehicles or pedestrians to a controller.

Capacity – The maximum sustainable hourly flow rate at which persons or vehicles reasonably can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions.

Case – See *degree-of-conflict case*.

Central area pricing – An areawide implementation of congestion pricing that imposes tolls for vehicles both entering and traveling within a central area street network during certain hours of certain days.

Central business district (CBD) – An area with characteristics including narrow street rights-of-way, frequent parking maneuvers, vehicle blockages, taxi and bus activity, small-radius turns, limited use of exclusive turn lanes, high pedestrian activity, dense population, and midblock curb cuts.

Change interval – See *yellow change interval*.

Circulating flow – The flow conflicting with the entry flow on the subject approach to a roundabout (i.e., the flow passing in front of the splitter island next to the subject entry).

Circulation area – 1. The portion of a sidewalk intended to be used for pedestrian movement. 2. The average area available to each person using a pedestrian facility.

Circulation time-space – The total available time-space minus the time-space occupied by pedestrians waiting to cross a crosswalk.

Circulatory roadway – The continuous-flow section of a roundabout that requires other vehicles entering the roadway to yield.

Class I two-lane highways – Highways where motorists expect to travel at relatively high speeds, such as major intercity routes, primary connectors of major traffic generators, daily commuter routes, or major links in state or national highway networks.

Class II two-lane highways – Highways where motorists do not necessarily expect to travel at high speeds, such as access routes to Class I facilities, scenic or recreational routes, or routes passing through rugged terrain.

Class III two-lane highways – Highways serving moderately developed areas, such as portions of a Class I or Class II highway that pass through small towns or developed recreational areas.

Clearance interval – See *red clearance interval*.

Clearance lost time – The time at the end of a signal phase during which the movements served by that phase are not used by any traffic because drivers decelerate and stop in response to the presentation of a yellow indication.

Clearance time – **1.** The interval after a bus is ready to depart during which a loading area is not available for use by a following bus, consisting of the sum of reentry delay and the time for a bus to start up and travel its own length, clearing the stop. **2.** See *clearance lost time* and *red clearance interval*.

Climbing lane – A passing lane added on an upgrade to allow traffic to pass heavy vehicles whose speeds are reduced.

Cloverleaf interchange – An interchange with four loop ramps and four diagonal ramps, with no traffic control on either crossing roadway.

Collector street – A surface street providing land access and traffic circulation within residential, commercial, and industrial areas.

Collector–distributor road (C-D road) – A continuous roadway without local access provided parallel to a freeway mainline through one or more interchanges for the purpose of removing weaving movements or closely spaced merges and diverges from the mainline.

Common green time – The period of time when the phases at the two intersections of an interchange both provide a green indication to a particular origin–destination movement.

Complete trip – A vehicle that enters the spatial domain of an analysis during the analysis period and is able to exit the domain successfully before the end of the analysis period.

Composite grade – A series of adjacent grades along a highway that cumulatively has a more severe effect on operations than each grade separately.

Compressed diamond interchange – A diamond interchange with a separation of 400 to 800 ft between the two intersections.

Computational engine – A software implementation of one or more models.

Conflict – The crossing, merging, or diverging of two traffic movements at an intersection.

Conflicting approach – At an all-way STOP-controlled intersection, an approach to the left or right of the subject approach.

Conflicting flow rate – The total flow rate in conflict with a specific movement at an unsignalized intersection.

Conflicting movements – Vehicular, pedestrian, or bicycle streams that seek to occupy the same space at the same time.

Congestion – **1.** Low-flow, high-occupancy traffic operations that arise when demand approaches or exceeds a system element's capacity. **2.** A difference between the highway system performance expected by users and how the system actually performs—for example, an intersection that may seem very congested in a rural community may not even register as an annoyance in a large metropolitan area.

Congestion pricing – The practice of charging tolls for use of all or part of a facility or a central area according to the severity of congestion.

Continuous-flow interchange – A diamond interchange form where left-turning traffic from the arterial street to an on-ramp is crossed to the left side of the roadway in advance of the interchange. Between the crossover and the near ramp terminal, the left-turning traffic travels in its own roadway between the opposing through arterial street traffic (on its right) and right-turning traffic from the off-ramp (on its left). The left-turning traffic continues straight at the near ramp terminal and turns left onto the on-ramp at the far ramp terminal without conflict from opposing through vehicular traffic. Also known as a displaced left-turn interchange.

Control condition – The traffic controls and regulations in effect for a segment of street or highway, including the type, phasing, and timing of traffic signals; STOP signs; lane use and turn controls; and similar measures.

Control delay – Delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed.

Controlled – Having a traffic control device that interrupts traffic flow (e.g., a traffic signal, STOP sign, or YIELD sign).

Conventional diamond interchange – A diamond interchange with a separation of 800 ft or more between the two intersections.

Coordinated actuated control – A variation of semiactuated operation that uses the controller's force-off settings to constrain the noncoordinated phases associated with the minor movements such that the coordinated phases are served at the appropriate time during the signal cycle and progression for the major movements is maintained.

Corridor – A set of parallel transportation facilities, for example a freeway and an arterial street.

Crawl speed – The maximum sustained speed that can be maintained by a specified type of vehicle on a constant upgrade of a given percent.

Critical density – The density at which capacity occurs for a given facility.

Critical headway – The minimum headway in the major traffic stream that will allow the entry of one minor-street vehicle.

Critical lane groups – The lane groups that have the highest flow ratio for a given signal phase.

Critical phase – One phase of a set of phases that occur in sequence and whose combined flow ratio is the largest for the signal cycle.

Critical segment – The segment that will break down first, given that all traffic, roadway, and control conditions do not change, including the spatial distribution of demands on each component segment.

Critical speed – The speed at which capacity occurs for a segment.

Critical volume-to-capacity ratio – The proportion of available intersection capacity used by vehicles in critical lane groups.

Cross flow – A pedestrian flow that is approximately perpendicular to and crosses another pedestrian stream. The smaller of the two flows is the cross-flow condition.

Crossing time – The curb-to-curb crossing distance divided by the pedestrian walking speed specified in the *Manual on Uniform Traffic Control Devices*.

Crosswalk – See *pedestrian crosswalk*.

Crosswalk occupancy time – The product of the pedestrian service time and the number

of pedestrians using a crosswalk during one signal cycle.

Curb extension – An extension of the sidewalk to the edge of the travel or bicycle lane.

Cycle – A complete sequence of signal indications.

Cycle failure – A condition where one or more queued vehicles are not able to depart an intersection as a result of insufficient capacity during the cycle in which they arrive.

Cycle length – The time elapsed between the endings of two sequential terminations of a given interval. For coordinated signals, this is measured by using the coordinated phase green interval.

Cyclic spillback – A condition where the downstream boundary intersection is signalized and its queue backs into the upstream intersection as a result of queue growth during the red indication.

D-factor – The proportion of traffic moving in the peak direction of travel on a given roadway during the peak hour.

Daily service volume – The maximum total daily volume in both directions that can be sustained in a given segment without violating the criteria for LOS *i* in the peak direction in the worst 15 min of the peak hour under prevailing roadway, traffic, and control conditions.

Deceleration lane – A paved noncontinuous lane, including tapered areas, allowing vehicles leaving the through-traffic lane of the roadway to decelerate.

Default value – A representative value that may be appropriate in the absence of local data.

Degree-of-conflict case – For all-way STOP-controlled intersections, a particular combination of vehicle presence on other approaches with respect to the subject approach.

Degree of saturation – See *demand-to-capacity ratio*.

Delay – Additional travel time experienced by a driver, passenger, bicyclist, or pedestrian beyond that required to travel at the desired speed.

Delayed passing maneuver – The inability of an average bicyclist to make a passing

maneuver immediately due to the presence of both another path user ahead of the overtaking average bicyclist in the subject direction and a path user in the opposing direction.

Demand – The number of vehicles or other roadway users desiring to use a given system element during a specific time period, typically 1 h or 15 min.

Demand flow rate – The count of vehicles arriving at the system element during the analysis period, converted to an hourly rate. When measured in the field, this flow rate is based on a traffic count taken upstream of the queue associated with the system element. This distinction is important for counts made during congested periods because the count of vehicles departing the system element will produce a demand flow rate that is lower than the true rate.

Demand starvation – A condition occurring when a signalized approach has adequate capacity but a significant portion of the traffic demand is held upstream and cannot use the capacity provided because of the signalization pattern.

Demand volume – The number of vehicles that arrive to use the facility. Under noncongested conditions, demand volume is equal to the observed volume.

Demand-to-capacity ratio – The ratio of demand volume to capacity for a system element.

Density – The number of vehicles occupying a given length of a lane or roadway at a particular instant. See also *pedestrian density*.

Departure headway – The average time between departures of successive vehicles on a given approach at an all-way STOP-controlled intersection.

Descriptive model – A model that shows how events unfold given a logic that describes how the objects involved will behave.

Design hour – An hour with a traffic volume that represents a reasonable value for designing the geometric and control elements of a facility.

Design hour factor – The proportion of the AADT that occurs during the design or analysis hour. See also *K-factor*.

Design-level analysis – An application of the HCM to establish the detailed physical features that will allow a new or modified

facility to operate at a desired LOS or performance value.

Design speed – A speed used to design the horizontal and vertical alignments of a highway.

Detection zone – The portion of a signalized intersection approach where a vehicle can be detected by the signal controller (with use of in-pavement loops or other technology), resulting in the display of the green indication for the approach being extended.

Deterministic model – A mathematical model that is not subject to randomness. For a given set of inputs, the result from the model is the same with each application.

Deterministic queue delay – The component of control delay representing the delay to all vehicles arriving during the analysis period when the demand flow rates exceed the capacity of an approach, computed by accumulating the vehicular inputs and outputs under the assumption of uniform arrivals.

Diamond interchange – An interchange form where one diagonal connection is made for each freeway entry and exit, with one connection per quadrant.

Directional design hour volume – The traffic volume for the design hour in the peak direction of flow.

Directional distribution – A characteristic of traffic that volume may be greater in one direction than in the other during any particular hour on a highway. See also *D-factor*.

Directional flow rate – The flow rate of a highway in one direction.

Directional segment – A length of two-lane highway in one travel direction with homogeneous cross sections and relatively constant demand volume and vehicle mix.

Directional split – See *D-factor*.

Diverge – A movement in which a single stream of traffic separates into two streams without the aid of traffic control devices.

Diverge segment – See *freeway diverge segment*.

Diverging diamond interchange – A diamond interchange form where through traffic on the arterial switches sides of the street at each of the ramp terminals, allowing left turns to ramps to be made without conflict from opposing through vehicular traffic.

Double-crossover interchange – See *diverging diamond interchange*.

Downstream – The direction of traffic flow.

Driver population factor – A parameter that accounts for driver characteristics that differ from base conditions and their effects on traffic.

Dual entry – A mode of operation (in a multiring controller) in which one phase in each ring must be in service. If a call does not exist in a ring when it crosses the barrier, a phase is selected in that ring to be activated by the controller in a predetermined manner.

Duration of congestion – The amount of time that congestion persists within a transportation system.

Dwell time – The sum of the time required to serve passengers at a transit stop and the time required to open and close the vehicle doors.

Dwell time variability – The distribution of dwell times at a stop because of fluctuations in passenger demand for buses and routes.

Dynamic traffic assignment model – A descriptive model that is based on an objective (e.g., minimize the travel time or disutility associated with a trip) that is gradually improved over a sequence of iterations until the network reaches a state of equilibrium.

E Effective available time-space – The available crosswalk time-space, adjusted to account for the effect turning vehicles have on pedestrians.

Effective green time – The time during which a given traffic movement or set of movements may proceed at the saturation flow rate; it is equal to the split time minus the lost time.

Effective red time – The time during which a given traffic movement or set of movements is directed to stop; it is equal to the cycle length minus the effective green time.

Effective walk time – The time that a WALK indication is displayed to a crosswalk, plus the portion of the DON'T WALK indication used by pedestrians to initiate their crossing.

Effective walkway width – The portion of a pedestrian facility's width that is usable for pedestrian circulation.

85th percentile speed – A speed value that is exceeded by 15% of the vehicles in a traffic stream.

Empirical model – A model that describes system performance and that is based on the statistical analysis of field data.

Entrance ramp – See *on-ramp*.

Entry flow – The traffic flow entering a roundabout on the subject approach.

Environmental conditions – Conditions such as adverse weather, bright sunlight directly in drivers' eyes, and abrupt transitions from light to dark (such as at a tunnel entrance on a sunny day) that may cause drivers to slow down and increase their spacing, resulting in a drop in a roadway's capacity.

Event – A meeting or a passing on a shared-use path or bicycle facility.

Event-based model – A simulation model that advances from one event to the next, skipping over intervening points in time when no event occurs.

Excess wait time – The average number of minutes transit passengers must wait at a stop past the scheduled departure time.

Exclusive bus lane – A highway or street lane reserved for buses.

Exclusive off-street bicycle paths – Paths physically separated from highway traffic provided for the exclusive use of bicycles.

Exclusive turn lane – A designated left- or right-turn lane used only by vehicles making those turns.

Exit flow – The traffic flow exiting a roundabout to the subject leg.

Exit ramp – See *off-ramp*.

Extent of congestion – The maximum geographic length of the congestion on a transportation system at any one time.

F Facility – A length of roadway, bicycle path, or pedestrian walkway composed of a connected series of points and segments.

Failure rate – The probability that a bus will arrive at a bus stop and find all available loading areas already occupied by other buses.

Far-side stop – A transit stop where transit vehicles cross an intersection before stopping to serve passengers.

Fixed-object effective width – The sum of the physical width of a fixed object along a

walkway or sidewalk, any functionally unusable space associated with the object, and the buffer given it by pedestrians.

Fixed obstruction – A nonmovable object along a roadway, including light poles, signs, trees, abutments, bridge rails, traffic barriers, and retaining walls.

Flared approach – At two-way STOP-controlled intersections, a shared right-turn lane that allows right-turning vehicles to complete their movement while other vehicles are occupying the lane.

Flow rate – The equivalent hourly rate at which vehicles or other roadway users pass over a given point or section of a lane or roadway during a given time interval of less than 1 h, usually 15 min.

Flow ratio – The ratio of the actual flow rate to the saturation flow rate for a lane group at an intersection.

Follow-up headway – The time between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway, under a condition of continuous queuing on the minor street.

Follower density – The number of followers per mile per lane; the following state is defined as a condition in which a vehicle is following its leader by no more than 3 s.

Force-off – A point within a cycle where an actuated phase must end regardless of continued demand. These points in a coordinated cycle ensure that the coordinated phases are provided a minimum amount of green time.

Four-phase pattern – A type of operation at an all-way STOP-controlled intersection with multilane approaches, where drivers from a given approach enter the intersection together, as right-of-way passes from one approach to the next and each is served in turn.

Free flow – A flow of traffic unaffected by upstream or downstream conditions.

Free-flow speed – 1. The theoretical speed when the density and flow rate on a study segment are both zero. 2. The prevailing speed on freeways at flow rates between 0 and 1,000 passenger cars per hour per lane (pc/h/ln).

Freeway – A fully access-controlled, divided highway with a minimum of two lanes (and frequently more) in each direction.

Freeway auxiliary lane – An additional lane on a freeway to connect an on-ramp and an off-ramp.

Freeway diverge segment – A freeway segment in which a single traffic stream divides to form two or more separate traffic streams.

Freeway facility – An extended length of freeway composed of continuously connected basic freeway, weaving, merge, and diverge segments.

Freeway facility capacity – The capacity of the critical segment among those segments composing a defined freeway facility.

Freeway merge segment – A freeway segment in which two or more traffic streams combine to form a single traffic stream.

Freeway section – A portion of a freeway facility with a constant demand and a constant number of lanes.

Freeway weaving segment – Freeway segments in which two or more traffic streams traveling in the same general direction cross paths along a significant length of freeway without the aid of traffic control devices (except for guide signs).

Full stop – The slowing of a vehicle to less than 5 mi/h.

Fully actuated control – A signal operation in which vehicle detectors at each approach to the intersection control the occurrence and length of every phase.

Furniture zone – The portion of the sidewalk between the curb and the area reserved for pedestrian travel; it may be used for landscaping, utilities, or pedestrian amenities.

Gap – The space or time between two vehicles, measured from the rear bumper of the front vehicle to the front bumper of the second vehicle. See also *headway*.

Gap acceptance – The process by which a driver accepts an available gap in traffic to perform a maneuver.

Gap out – A type of actuated operation for a given phase where the phase terminates because of a lack of vehicle calls within the passage time.

General terrain – An extended length of highway containing a number of upgrades and downgrades where no single grade is

long enough or steep enough to have a significant impact on the operation of the overall segment.

Generalized service volume table – A sketch-planning tool that provides an estimate of the maximum volume a system element can carry at a given level of service, given a default set of assumptions about the system element.

Geometric condition – The spatial characteristics of a facility, including approach grade, the number and width of lanes, lane use, and parking lanes.

Geometric delay – Delay caused by geometric features causing vehicles to reduce their speed in negotiating a system element.

Gore area – The area located immediately between the left edge of a ramp pavement and the right edge of the roadway pavement at a merge or diverge area.

Green time – The duration of the green indication for a given movement at a signalized intersection.

Green time (g/C) ratio – The ratio of the effective green time of a phase to the cycle length.

Growth factor – A percentage increase applied to current traffic demands to estimate future demands.

Hard conversion – The conversion of a value from U.S. customary units to metric units (or vice versa) through the application of rounding, such as from 12 ft to 3.6 m. See also *soft conversion*.

Headway – The time between two successive vehicles as they pass a point on the roadway, measured from the same common feature of both vehicles (for example, the front axle or the front bumper).

Heavy vehicle – A vehicle with more than four wheels touching the pavement during normal operation.

High-occupancy vehicle (HOV) – A vehicle with a defined minimum number of occupants (>1); HOVs often include buses, taxis, and carpools, when a lane is reserved for their use.

Highway – A general term for denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Hindrance – Discomfort and inconvenience to a bicyclist as a result of meeting, passing, or being overtaken by other pathway users.

Holding area waiting time – The average time that pedestrians wait to cross the street in departing from the subject corner.

Hybrid models – Models used with very large networks that apply microscopic modeling to critical subnetworks and mesoscopic or macroscopic modeling to the connecting facilities.

Impedance – The reduction in the capacity of lower-rank movements caused by the congestion of higher-rank movements at a two-way STOP-controlled intersection.

Incident – Any occurrence on a roadway that impedes the normal flow of traffic.

Incident delay – The component of delay that results from an incident, compared with the no-incident condition.

Incomplete trip – A vehicle that is unable to enter and exit successfully the spatial domain of an analysis within the analysis period.

Incremental delay – The second term of lane group control delay, accounting for delay due to the effect of random, cycle-by-cycle fluctuations in demand that occasionally exceed capacity (i.e., cycle failure) and delay due to sustained oversaturation during the analysis period.

Influence area – **1.** The base length of a freeway weaving segment plus 500 ft upstream of the entry point to the weaving segment and 500 ft downstream of the exit point from the weaving segment; entry and exit points are defined as the points where the appropriate edges of the merging and diverging lanes meet. **2.** The acceleration lane(s) and Lanes 1 and 2 of the freeway mainline for a distance of 1,500 ft downstream of the merge point. **3.** The deceleration lane(s) and Lanes 1 and 2 of the freeway for a distance of 1,500 ft upstream of the diverge point.

Initial queue – The unmet demand at the beginning of an analysis period, either observed in the field or carried over from the computations of a previous analysis period.

Initial queue delay – The third term of lane group control delay, accounting for delay due to a residual queue identified in a previous analysis period and persisting at the start of the current analysis period. This

delay results from the additional time required to clear the initial queue.

Inputs – The data required by a model.

Instantaneous acceleration – An acceleration determined from the relative speeds of a vehicle at time t and time $t - \Delta t$, assuming a constant acceleration during Δt .

Instantaneous speed – A speed determined from the relative positions of a vehicle at time t and time $t - \Delta t$, assuming a constant acceleration during Δt .

Intelligent transportation system (ITS) – Transportation technology that allows drivers and traffic control system operators to gather and use real-time information to improve vehicle navigation, roadway system control, or both.

Intensity of congestion – The amount of congestion experienced by users of a system.

Interchange – A system of interconnecting roadways providing for traffic movement between two or more highways that do not intersect at grade.

Interchange density – The average number of interchanges per mile, measured over 3 mi upstream and 3 mi downstream from the midpoint of the weaving segment.

Interchange ramp terminal – A junction of a ramp with a surface street serving vehicles entering or exiting a freeway.

Internal link – The segment between two signalized intersections at an interchange ramp terminal.

Interrupted flow – Traffic flow on facilities characterized by traffic signals, STOP signs, YIELD signs, or other fixed causes of periodic delay or interruption to the traffic stream.

Intersection delay – The total additional travel time experienced by drivers, passengers, or pedestrians as a result of control measures and interaction with other users of the facility, divided by the volume departing from the corresponding cross section of the facility.

Interval – A period of time in which all traffic signal indications remain constant.

Isolated intersection – An intersection experiencing negligible influence from upstream signalized intersections, where flow is effectively random over the cycle and without a discernible platoon pattern evident in the cyclic profile of arrivals.

Jam density – The maximum density that can be achieved on a segment. It occurs when speed is zero (i.e., when there is no movement of persons or vehicles).

K-factor – The proportion of AADT that occurs during the peak hour. See also *design hour factor*.

Lane 1 – The highway lane adjacent to the outside shoulder.
Lane 2 – The highway lane adjacent to and left of Lane 1.

Lane balance – A condition when the number of lanes leaving a diverge point is equal to the number of lanes approaching it, plus one.

Lane distribution – A parameter used when two or more lanes are available for traffic in a single direction and the volume distribution varies between lanes, depending on traffic regulation, traffic composition, speed and volume, the number of and location of access points, the origin–destination patterns of drivers, the development environment, and local driver habits.

Lane group – A lane or set of lanes designated for separate analysis.

Lane group delay – The control delay for a given lane group.

Lane utilization – The distribution of vehicles among lanes when two or more lanes are available for a movement. See also *prepositioning*.

Lane width – The lateral distance between stripes for a given lane.

Lateral clearance – **1.** The total left- and right-side clearance from the outside edge of travel lanes to fixed obstructions on a multilane highway. **2.** The right-side clearance distance from the rightmost travel lane to fixed obstructions on a freeway.

Leg – A set of lanes at an intersection accommodating all approaching movements to and departing movements from a given direction.

Level of service (LOS) – A quantitative stratification of a performance measure or measures that represent quality of service, measured on an A–F scale, with LOS A representing the best operating conditions

from the traveler's perspective and LOS F the worst.

Level of service score (LOS score) – A numerical output from a traveler perception model that typically indicates the average rating that travelers would give a transportation facility or service under a given set of conditions.

Level terrain – Any combination of grades and horizontal or vertical alignment that permits heavy vehicles to maintain the same speed as passenger cars, typically containing short grades of no more than 2%.

Light rail mode – A transit mode operated by vehicles that receive power from overhead wires and that run on tracks that can be located at grade within street rights-of-way. See also *streetcar mode*.

Link – A length of roadway between two nodes or points.

Link length – The urban street segment length minus the width of the upstream boundary intersection.

Load factor – The number of passengers occupying a transit vehicle divided by the number of seats on the vehicle.

Loading area – A curbside space where a single bus can stop to load and unload passengers; bus stops include one or more loading areas.

Local street – A street that primarily serves a land-access function.

Local transit service – Transit service making regular stops along a street (typically every 0.25 mi or less).

Loop ramp – A ramp requiring vehicles to execute a left turn by turning right, accomplishing a 90-degree left turn by making a 270-degree right turn.

Lost time – The time during which a movement's phase is active and the approach is not used effectively by that movement; it is the sum of clearance lost time and start-up lost time.

M **Macroscopic model** – A mathematical model that considers traffic operations averaged over specified time intervals and specified segments or links without recognizing individual vehicles in the traffic stream.

Mainline – The primary through roadway as distinct from ramps, auxiliary lanes, and collector-distributor roads.

Mainline output – The maximum number of vehicles that can exit a freeway node, constrained by downstream bottlenecks or by merging traffic.

Major diverge area – A junction where one freeway segment diverges to form two primary freeway segments with multiple lanes.

Major merge area – A junction where two primary freeway segments, each with multiple lanes, merge to form a single freeway segment.

Major street – The street not controlled by STOP signs at a two-way STOP-controlled intersection.

Major weaving segment – A weaving segment with at least three entry and exit legs, each with two or more lanes.

Managed lanes – A limited number of lanes set aside within a freeway cross section where multiple operational strategies are utilized and actively adjusted as needed for the purpose of achieving predefined performance objectives. Examples include priced lanes and special-use lanes such as high-occupancy vehicle, express, bus-only, or truck-only lanes.

Max out – A type of actuated operation for a given phase where the phase terminates because it has reached the designated maximum green time for the phase.

Maximum green – The maximum amount of time that a green signal indication can be displayed in the presence of conflicting demand.

Maximum recall – A form of phase recall where the controller places a continuous call for vehicle service on the phase. This results in the presentation of the green indication for its maximum duration every cycle.

Maximum weaving length – The length at which weaving turbulence no longer has an impact on the capacity of the weaving segment.

Median – The area in the middle of a roadway separating opposing traffic flows.

Meeting – An encounter of bicycles or pedestrians moving in the opposite direction of the subject bicycle flow.

Merge – A movement in which two separate streams of traffic combine to form a single

stream without the aid of traffic signals or other right-of-way controls.

Merge segment – See *freeway merge segment*.

Mesoscopic model – A mathematical model for the movement of clusters or platoons of vehicles incorporating equations to indicate how the clusters interact.

Microscopic model – A mathematical model that captures the movement of individual vehicles and their car-following, lane-choice, and gap-acceptance decisions at small time intervals, usually by simulation.

Midblock stop – A transit stop located at a point away from intersections.

Minimum green – The least amount of time that a green signal indication will be displayed when a signal phase is activated.

Minimum recall – A form of phase recall where the controller places a continuous call for vehicle service on the phase and then services the phase until its minimum green interval times out. The phase can be extended if actuations are received.

Minor movement – A vehicle making a specific directional entry into an unsignalized intersection that must yield to other movements.

Minor street – The street controlled by STOP signs at a two-way STOP-controlled intersection.

Mixed-traffic operation – Operation of a transit mode in lanes shared with other roadway users.

Mobility – The ability of people and goods to travel from place to place.

Mode – See *travel mode*.

Model – A procedure that uses one or more algorithms to produce a set of numerical outputs describing the operation of a segment or system, given a set of numerical inputs.

Model application – The physical configuration and operational conditions to which a traffic analysis tool is applied.

Mountainous terrain – Any combination of grades and horizontal and vertical alignment that causes heavy vehicles to operate at crawl speed for significant distances or at frequent intervals.

Move-up time – The time it takes a vehicle to move from second position into first position on an approach to an all-way STOP-controlled intersection.

Movement capacity – The capacity of a specific traffic stream at a STOP-controlled intersection approach, assuming that the traffic has exclusive use of a separate lane.

Movement groups – An organization of traffic movements at a signalized intersection to facilitate data entry. A separate movement group is established for (a) each turn movement with one or more exclusive turn lanes and (b) the through movement (inclusive of any turn movements that share a lane).

Multilane highway – A highway with at least two lanes for the exclusive use of traffic in each direction, with no control or partial control of access, but that may have periodic interruptions to flow at signalized intersections no closer than 2 mi.

Multilane roundabout – A roundabout with more than one lane on at least one entry and at least part of the circulatory roadway.

Multimodal – Being used by more than one travel mode.

Multimodal analysis – A type of HCM analysis where the LOS of each travel mode on a facility is evaluated simultaneously.

Multiple weaving segment – A portion of a freeway where a series of closely spaced merge and diverge areas creates overlapping weaving movements (between different merge-diverge pairs).

Near-side stop – A transit stop located on the approach side of an intersection. Transit vehicles stop to serve passengers before crossing the intersection.

No-passing zone – A segment of a two-lane, two-way highway along which passing is prohibited in one or both directions.

Node – The endpoint of a link. See also *point*.

Nonlocal transit service – Transit service on routes with longer stop spacing than local service (e.g., limited-stop, bus rapid transit, or express routes).

Nonweaving flow – The traffic movements in a weaving segment that are not engaged in weaving movements.

Nonweaving movement – A traffic flow within a weaving segment that does not need to cross paths with another traffic flow while traversing the segment.

Normative model – A mathematical model that identifies a set of parameters providing the best system performance.

O **Off-line bus stop** – See *bus stop*.

Off-ramp – A ramp that accommodates diverging maneuvers.

Off-street path – See *shared pedestrian–bicycle path*.

Offset – The time that the reference phase begins (or ends) relative to the system master time zero.

On-line bus stop – See *bus stop*.

On-ramp – A ramp that accommodates merging maneuvers.

On-street transitway – A portion of a street right-of-way dedicated to the transit mode, physically segregated from other traffic, and located in the median or adjacent to one side of the street.

One-sided weaving segment – A weaving segment in which no weaving maneuvers require more than two lane changes to be completed successfully.

Operations-level analysis – An application of an HCM methodology where the user supplies all or nearly all required inputs to the procedure.

Opposing approach – At an all-way STOP-controlled intersection, the approach approximately 180 degrees opposite the subject approach.

Opposing flow rate – The flow rate for the direction of travel opposite to the direction under analysis.

Outputs – The performance measures produced by a model.

Overflow queue – Queued vehicles left over after a green phase at a signalized intersection.

Oversaturated flow – Traffic flow where (a) the arrival flow rate exceeds the capacity of a point or segment, (b) a queue created from a prior breakdown of a facility has not yet dissipated, or (c) traffic flow is affected by downstream conditions.

P **Partial cloverleaf interchange (parclo)** – An interchange with one to three (typically two) loop ramps and two to four diagonal

ramps, with major turning movements desirably being made by right-turn exits and entrances.

Partial diamond interchange – A diamond interchange with fewer than four ramps, so that not all of the freeway–street or street–freeway movements are served.

Partial stop – A situation where a vehicle slows as it approaches the back of a queue but does not come to a full stop.

Passage time – The maximum amount of time one vehicle actuation can extend the green interval while green is displayed. It is input for each actuated signal phase; also referred to as vehicle interval, extension interval, extension, or unit extension.

Passenger-car equivalent – The number of passenger cars that will result in the same operational conditions as a single heavy vehicle of a particular type under specified roadway, traffic, and control conditions.

Passenger load factor – See *load factor*.

Passenger trip length – The average distance traveled by a passenger on board a transit vehicle.

Passing lane – A lane added to improve passing opportunities in one direction of travel on a conventional two-lane highway.

Passing sight distance – The length of highway required to complete normal passing maneuvers in which the passing driver can determine that there are no potentially conflicting vehicles ahead before beginning the maneuver.

Passive priority – A form of traffic signal priority that is pretimed, such as the setting of a street's signal progression to favor buses.

Pavement condition rating – A description of the road surface in terms of ride quality and surface defects.

Peak hour – The hour of the day in which the maximum volume occurs. See also *analysis hour*.

Peak hour factor (PHF) – The hourly volume during the analysis hour divided by the peak 15-min flow rate within the analysis hour; a measure of traffic demand fluctuation within the analysis hour.

Pedestrian – An individual traveling on foot.

Pedestrian clear interval – Time provided for pedestrians who depart the curb during the WALK indication to reach the opposite curb (or the median).

Pedestrian crosswalk – A connection between pedestrian facilities across sections of roadway used by automobiles, bicycles, and transit vehicles. Crosswalks can be marked or unmarked.

Pedestrian density – The number of pedestrians per unit of area within a walkway or queuing area.

Pedestrian flow rate – The number of pedestrians passing a point per unit of time. See also *unit width flow rate*.

Pedestrian mode – A travel mode under which a journey (or part of a journey) is made on foot along a roadway or pedestrian facility.

Pedestrian overpass – A grade-separated pedestrian facility over such barriers as wide or high-speed roadways, railroad tracks, busways, or topographic features.

Pedestrian plaza – A large, paved area that serves multiple functions, including pedestrian circulation, special events, and seating.

Pedestrian queuing area – A place where pedestrians stand temporarily while waiting to be served, such as at the corner of a signalized intersection.

Pedestrian recall – A form of phase recall where the controller places a continuous call for pedestrian service on the phase and then services the phase for at least an amount of time equal to its walk and pedestrian clear intervals (longer if vehicle detections are received).

Pedestrian service time – The elapsed time starting with the first pedestrian's departure from the corner to the last pedestrian's arrival at the far side of the crosswalk.

Pedestrian space – The average area provided for pedestrians in a moving pedestrian stream or pedestrian queue.

Pedestrian start-up time – The time for a platoon of pedestrians to get under way following the beginning of the walk interval.

Pedestrian street – A street dedicated to pedestrian use on a full- or part-time basis.

Pedestrian underpass – A grade-separated pedestrian facility under such barriers as wide or high-speed roadways, railroad tracks, busways, or topographic features.

Pedestrian walkway – A pedestrian facility similar to a sidewalk in construction but located well away from the influence of automobile traffic.

Percent free-flow speed – The average travel speed divided by the free-flow speed.

Percent time-spent-following – The average percent of total travel time that vehicles must travel in platoons behind slower vehicles because of inability to pass on a two-lane highway.

Performance measure – A quantitative or qualitative characterization of some aspect of the service provided to a specific road user group.

Permitted plus protected – Compound left-turn protection that displays the permitted phase before the protected phase.

Permitted turn – A left or right turn at a signalized intersection that is made by a vehicle during a time in the cycle in which the vehicle does not have the right-of-way.

Person capacity – The maximum number of persons who can pass a given point during a specified period under prevailing conditions.

Phase – The part of the signal cycle allocated to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals. A phase includes the green, yellow change, and red clearance intervals.

Phase pair – See *barrier pair*.

Phase pattern – The alternation of right-of-way among various traffic streams at an all-way STOP-controlled intersection.

Phase recall – A call made by the controller for a specified phase each time the controller is servicing a conflicting phase.

Phase sequence – **1.** The sequence of service provided to each traffic movement. **2.** A description of the order in which the left-turn movements are served relative to the through movements.

Planning-level analysis – An application of the HCM generally directed toward broad issues such as initial problem identification (e.g., screening a large number of locations for potential operations deficiencies), long-range analyses, and statewide performance monitoring. Nearly all inputs to the analysis may be defaulted.

Platoon – A group of vehicles or pedestrians traveling together as a group, either voluntarily or involuntarily because of signal control, geometrics, or other factors.

Platoon ratio – A description of the quality of signal progression computed as the demand flow rate during the green indication divided by the average demand flow rate.

Point – A place along a facility where (a) conflicting traffic streams cross, merge, or diverge; (b) a single traffic stream is regulated by a traffic control device; or (c) there is a significant change in the segment capacity (e.g., lane drop, lane addition, narrow bridge, significant upgrade, start or end of a ramp influence area).

Potential capacity – The capacity of a specific movement at a STOP-controlled intersection approach, assuming that it is unimpeded by pedestrian or higher-rank movements and has exclusive use of a separate lane.

Precision – The size of the estimation range for a measured quantity.

Preliminary engineering-level analysis – An HCM application conducted to support planning decisions related to roadway design concept and scope, when alternatives analyses are performed, or to assess proposed systemwide policies. Many of the inputs to the analysis will be defaulted.

Prepositioning – A deliberate driver choice of one lane over another at an intersection in anticipation of a turn at a downstream intersection.

Pretimed control – A signal control in which the cycle length, phase plan, and phase times are preset to repeat continuously.

Prevailing condition – The geometric, traffic, control, and environmental conditions during the analysis period.

Progression – The act of various controllers providing specific green indications in accordance with a time schedule to permit continuous operation of groups of vehicles along the street at a planned speed.

Protected plus permitted – Compound left-turn protection at a signalized intersection that displays the protected phase before the permitted phase.

Protected turn – The left or right turns at a signalized intersection that are made by a vehicle during a time in the cycle when the vehicle has the right-of-way.

Q

Quality of service – A description of how well a transportation facility or service operates from a traveler's perspective.

Quantity of service – A measure of the utilization of a transportation system.

Queue – A line of vehicles, bicycles, or persons waiting to be served due to traffic control, a bottleneck, or other causes.

Queue delay – 1. The amount of time that a vehicle spends in a queued state. 2. When computed from vehicle trajectories, it is the accumulated time step delay over all time steps in which the vehicle is in a queue.

Queue discharge flow – A traffic flow that has passed through a bottleneck and, in the absence of another downstream bottleneck, is accelerating to the free-flow speed of the freeway.

Queue jump – A short bus lane section (often shared with a right-turn lane), in combination with an advance green indication for the lane, that allows buses to move past a queue of cars at a signal.

Queue length – The distance between the upstream and downstream ends of the queue.

Queue spillback – A condition where the back of a queue extends beyond the available storage length, resulting in potential interference with upstream traffic movements.

Queue storage ratio – The maximum back of queue as a proportion of the available storage on the subject lane or link.

Queued state – A condition when a vehicle is within one car length (20 ft) of a stopped vehicle and is itself in a stopped state (i.e., has slowed to less than 5 mi/h).

Ramp – A dedicated roadway providing a connection between two other roadways; at least one of the roadways a ramp connects is typically a high-speed facility such as a freeway, multilane highway, or C-D roadway.

Ramp-freeway junction – The point of connection between a ramp and a high-speed facility such as a freeway, multilane highway, or C-D roadway.

Ramp meter – A traffic signal that controls the entry of vehicles from a ramp onto a limited-access facility; the signal allows one or two vehicles to enter on each green or green flash.

Ramp roadway – See *ramp*.

Ramp-street junction – See *interchange ramp terminal*.

Rank – The hierarchy of right-of-way among conflicting traffic streams at a two-way STOP-controlled intersection.

Reasonable expectancy – The concept that the stated capacity for a given system element is one that can be achieved repeatedly during peak periods, rather than being the absolute maximum flow rate that could be observed.

Receiving lanes – Lanes departing an intersection.

Recreational vehicle – A heavy vehicle, generally operated by a private motorist, for transporting recreational equipment or facilities; examples include campers, motor homes, and vehicles towing boat trailers.

Red clearance interval – A brief period of time following the yellow indication during which the signal heads associated with the ending phase and all conflicting phases display a red indication.

Red time – The period in the signal cycle during which, for a given phase or lane group, the signal is red.

Reentry delay – Delay experienced by buses leaving a bus stop, when they must wait for a gap in traffic before reentering the travel lane.

Reference phase – One of the two coordinated phases (i.e., Phase 2 or 6).

Regression model – A model that uses field or simulated data to develop statistically derived relationships between particular model inputs and performance measures such as capacity and delay.

Residual queue – The unmet demand at the end of an analysis period resulting from operation while demand exceeded capacity.

Rest-in-walk mode – A signal controller setting in which the phase will dwell in walk as long as there are no conflicting calls. When a conflicting call is received, the pedestrian clear interval will time to its setting value before ending the phase.

Restrictive median – A median (for example, a raised curb) that prevents or discourages vehicles from crossing the opposing traffic lanes.

Right-turn-on-red – The ability to make a right turn at a signalized intersection when a red indication is displayed, after stopping and only when no conflicting vehicular or pedestrian traffic is present.

Ring – A set of phases operating in sequence.

Roadside obstruction – An object or barrier along a roadside or median that affects traffic flow, whether continuous (e.g., a retaining wall) or not continuous (e.g., light supports or bridge abutments).

Roadway – That portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes but exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm, or shoulder is used by persons riding bicycles or other human-powered vehicles.

Roadway characteristic – A geometric characteristic of a street or highway, including the type of facility, number and width of lanes (by direction), shoulder widths and lateral clearances, design speed, and horizontal and vertical alignments.

Rolling terrain – Any combination of grades and horizontal or vertical alignment that causes heavy vehicles to reduce their speed substantially below that of passenger cars but that does not cause heavy vehicles to operate at crawl speeds for any significant length of time or at frequent intervals.

Roundabout – An intersection with a generally circular shape, characterized by yield on entry and circulation around a central island.

Rubbernecking – The slowing of motorists to observe a traffic incident.

Running speed – See *average running speed*.

Running time – The time that a vehicle traverses a length of roadway excluding any delay related to a control device.

Rural – An area with widely scattered development and a low density of housing and employment.

Saturation flow rate – The equivalent hourly rate at which previously queued vehicles can traverse an intersection approach under prevailing conditions, assuming that the green signal is available at all times and no lost times are experienced.

Saturation headway – 1. At a signalized intersection, the average headway between vehicles occurring after the fourth vehicle in the queue and continuing until the last vehicle in the initial queue clears the intersection. 2. At an all-way STOP-controlled intersection, the time between departures of successive vehicles on a given approach for a

particular case, assuming a continuous queue.

Scenario – See *model application*.

Segment – **1.** For interrupted flow facilities, a link and its boundary point(s). **2.** For uninterrupted flow facilities, a portion of a facility between two points.

Segment delay – **1.** The delay experienced by a vehicle since it left the upstream node (usually another signal), including traffic delay, incident delay, control delay, and geometric delay. **2.** When calculated from vehicle trajectories, the time actually taken to traverse a segment minus the time it would have taken to traverse the segment at the target speed. The segment delay on any time step is equal to the time step delay; segment delays accumulated over all time steps in which a vehicle is present on the segment represent the segment delay for that vehicle.

Segment initialization – The process of determining the appropriate number of vehicles in each segment as a precursor to estimating the number of vehicles on each freeway segment for each time step under oversaturated conditions.

Semiactuated control – A signal control in which some approaches (typically on the minor street) have detectors and some of the approaches (typically on the major street) have no detectors.

Sensitivity analysis – A technique for exploring how model outputs change in response to changes in model inputs, implemented by varying one input at a time over its reasonable range while holding all other inputs constant.

Service flow rate – The maximum directional rate of flow that can be sustained in a given segment under prevailing roadway, traffic, and control conditions without violating the criteria for LOS *i*.

Service measure – A performance measure used to define LOS for a transportation system element.

Service time – At an all-way STOP-controlled intersection, the departure headway minus the move-up time.

Service volume – The maximum hourly directional volume that can be sustained in a given segment without violating the criteria for LOS *i* during the worst 15 min of the hour (period with the highest density) under prevailing roadway, traffic, and control conditions.

Shared lane – **1.** A lane shared by more than one movement. **2.** A bicycle facility where bicycles share a travel lane with motorized vehicular traffic.

Shared-lane capacity – The capacity of a lane at an intersection that is shared by two or three movements.

Shared pedestrian–bicycle path – A path physically separated from highway traffic for the use of pedestrians, bicyclists, runners, inline skaters, and other nonmotorized users.

Shock wave – A change or discontinuity in traffic conditions. For example, a shock wave is generated when the signal turns red, and it moves upstream as vehicles arriving at the queue slow down. A shock wave is also generated when the signal turns green, and it moves downstream as the first set of vehicles discharge from the signal.

Short length – The distance within a weaving segment over which lane changing is not prohibited or dissuaded by markings.

Shoulder – A portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles; emergency use; and lateral support of the subbase, base, and surface courses.

Shoulder bikeway – A bicycle facility where bicyclists use a paved shoulder, separated by striping from motor vehicle traffic, for travel along a roadway.

Shoulder bypass lane – A portion of the paved shoulder opposite the minor-road leg at a three-leg intersection, marked as a lane for through traffic to bypass vehicles that are slowing or stopped to make a left turn.

Shy distance – The buffer that pedestrians give themselves to avoid accidentally stepping off the curb, brushing against a building face, or getting too close to pedestrians standing under awnings or window shopping.

Side street – See *minor street*.

Sidelpath – A shared pedestrian–bicycle path located parallel and in proximity to a roadway.

Sidewalk – A pedestrian facility located parallel and in proximity to a roadway.

Simple weaving segment – A weaving segment formed by a single merge point followed by a single diverge point.

Simultaneous gap out – A controller mode requiring that both phases reach a point of being committed to terminate (via gap out, max out, or force-off) at the same time.

Single entry – A mode of operation (in a multiring controller) in which a phase in one ring can be selected and timed alone if there is no demand for service in a nonconflicting phase on the parallel ring(s).

Single-point urban interchange – A diamond interchange that combines all the ramp movements into a single signalized intersection.

Single-stage gap acceptance – A condition where no median refuge area is available for minor-street drivers to store in, so that minor-street drivers must evaluate gaps in both major-street directions simultaneously.

Sketch-planning tools – Tools that produce general order-of-magnitude estimates of travel demand and transportation system performance under different transportation system improvement alternatives.

Soft conversion – The conversion of a value from U.S. customary units to metric units (or vice versa) through the application of a conversion factor, such as multiplying 12 ft by 0.305 ft/m, resulting in 3.66 m. See also *hard conversion*.

Space – See *pedestrian space*.

Space gap – See *gap*.

Space mean speed – An average speed based on the average travel time of vehicles to traverse a length of roadway.

Spacing – The distance between two successive vehicles in a traffic lane, measured from the same common feature of the vehicles (e.g., rear axle, front axle, or front bumper).

Spatial stop rate – The ratio of stop rate to facility length.

Spatial variability – Variability in measured values, such as the percentage of trucks in the traffic stream, from one location to another within an area or from one area to another.

Special events – Sources of high demand that occur at known times relatively infrequently, resulting in traffic flow patterns that vary substantially from the typical situation.

Specific grade – A single grade of a roadway segment or extended roadway segment expressed as a percentage.

Speed – A rate of motion expressed as distance per unit of time.

Speed harmonization – A technique to reduce the shock waves that typically occur when traffic abruptly slows upstream of a bottleneck or for an incident, through the use

of variable speed limits or advisory speed signs.

Spillback – See *queue spillback*.

Spillover – A condition occurring when pedestrians begin to use more than the provided sidewalk or walkway space (e.g., by stepping into the street) to travel at their desired speed.

Split – The segment of the cycle length allocated to each phase or interval that may occur. In an actuated controller unit, split is the time in the cycle allocated to a phase—the sum of the green, yellow change, and red clearance intervals for a phase.

Split-diamond interchange – Diamond interchanges in which freeway entry and exit ramps are separated at the street level, creating four intersections.

Stairway – A pedestrian facility that ascends a grade via a series of steps and landings.

Standee – A passenger standing in a transit vehicle.

Start-up lost time – The additional time consumed by the first few vehicles in a queue at a signalized intersection above and beyond the saturation headway because of the need to react to the initiation of the green phase and to accelerate.

Static flow model – A mathematical model in which the traffic flow rate and origin–destination volumes are constant.

Stochastic model – A mathematical model that uses random number generation for the determination of at least one parameter.

Stop rate – The count of full stops divided by the number of vehicles served.

Stop spacing – See *average bus stop spacing*.

Stopped delay – The amount of time that a vehicle is stopped. When calculated from vehicle trajectories, it is equal to the time step delay on any step in which the vehicle is in a stopped state. Time step delays accumulated over all time steps in which the vehicle was in the stopped state represent the stopped delay for that vehicle.

Stopped state – A condition when a vehicle is traveling at less than 5 mi/h.

Storage length – The length of turn lane available for storing queued vehicles.

Street – See *highway*.

Street corner – The area encompassed within the intersection of two sidewalks.

Streetcar mode – A transit mode operated by vehicles that receive power from overhead wires and run on tracks. Compared with light rail, streetcars are generally shorter and narrower, are more likely to have on-board fare collection, make more frequent stops, and are more likely to operate in mixed traffic.

Study period – See *analysis period*.

Subject approach – The approach under study at two-way and all-way STOP-controlled intersections.

Suburban street – A street with low-density driveway access on the periphery of an urban area.

Sustained spillback – A result of oversaturation, where a queue does not dissipate at the end of each cycle but remains present until the downstream capacity is increased or the upstream demand is reduced.

System – All the transportation facilities and modes within a particular region.

System elements – Components of a transportation system, including points, segments, facilities, corridors, and areas.

Taper area – An area characterized by a reduction or increase in pavement width to direct traffic.

Target speed – In a simulation tool, the speed at which a driver would prefer to travel; it differs from the free-flow speed in that most simulation tools apply a “driver aggressiveness” factor to the free-flow speed to determine a target speed.

Temporal variability – Variability in measured values, such as hourly traffic volumes, that occurs from day to day or month to month at a given location.

Terrain – See *general terrain*.

Three-level diamond interchange – A diamond interchange with two divided levels so that both facilities provide continuous through movements.

Through vehicles – All vehicles passing directly through a street segment and not turning.

Tight urban diamond interchange – A diamond interchange with a separation of less than 400 ft between the two intersections.

Time interval – See *analysis period*.

Time interval scale factor – The ratio of the total facility entrance counts to total facility exit counts.

Time mean speed – The average speed of vehicles observed passing a point on a highway.

Time gap – See *gap*.

Time-space domain – A specification of the freeway sections included in the defined facility and an identification of the time intervals for which the analysis is to be conducted.

Time step delay – The length of a time step minus the time it would have taken a vehicle to cover the distance traveled in the step at the target speed.

Time-varying flow model – A simulation model in which flow changes with time.

Tool – See *traffic analysis tool*.

Total lateral clearance (TLC) – The sum of the right-side and left-side lateral clearances along a multilane highway.

Total lost time – See *lost time*.

Total ramp density – The average number of on-ramp, off-ramp, major merge, and major diverge junctions per mile. It applies to a 6-mi segment of freeway facility, 3 mi upstream and 3 mi downstream of the midpoint of the study segment.

Traffic analysis tool – A software product used for traffic analysis that includes, at a minimum, a computational engine and a user interface.

Traffic condition – A characteristic of traffic flow, including distribution of vehicle types in the traffic stream, directional distribution of traffic, lane use distribution of traffic, and type of driver population on a given facility.

Traffic control device – A sign, signal, marking, or other device used to regulate, warn, or guide traffic.

Traffic delay – The component of delay that results when the interaction of vehicles causes drivers to reduce speed below the free-flow speed.

Traffic incidents – Occurrences, such as crashes, stalled cars, and debris in the roadway, that do not occur every day. These incidents reduce a roadway’s capacity and create variation in day-to-day travel times along the roadway.

Traffic pressure – The display of aggressive driving behavior for a large number of drivers during high-demand traffic

conditions. Under such conditions, a large number of drivers accept shorter headways during queue discharge than they would under different circumstances.

Traffic signal delay – Delay experienced by a bus that arrives at a near-side stop during the green interval, serves its passengers during portions of the green and red intervals, and then must wait for the traffic signal to turn green again before proceeding. See also *control delay*.

Traffic signal optimization tool – A tool primarily designed to develop optimal signal phasing and timing plans for isolated signalized intersections, arterial streets, or signal networks.

Transit frequency – The count of scheduled fixed-route transit vehicles that stop on or near an urban street segment during the analysis period.

Transit mode – A travel mode in which vehicles (including buses, streetcars, and street-running light rail) stop at regular intervals along the roadway to pick up and drop off passengers.

Transit reliability – A measure of the time performance and the regularity of headways between successive transit vehicles affecting the amount of time passengers must wait at a transit stop as well as the consistency of a passenger's arrival time at a destination.

Transit signal preemption – The transfer of normal operation of a traffic signal to a special control mode serving a transit vehicle.

Transit signal priority – Adjustments to traffic signal timing to provide more usable green time to transit vehicles. See also *active priority* and *passive priority*.

Transitway – See *on-street transitway*.

Travel demand models – Models that forecast long-term future travel demand on the basis of current conditions and projections of socioeconomic characteristics and changes in transportation system design.

Travel mode – 1. A transport category characterized by specific right-of-way, technological, and operational features.
2. A particular form of travel, for example, walking, bicycling, traveling by automobile, or traveling by bus.

Travel speed – See *average travel speed*.

Travel time – The average time spent by vehicles traversing a highway segment, including control delay.

Travel time rate – The reciprocal of speed, expressed as time per unit distance traveled.

Travel time reliability – 1. The probability of "on-time" arrival (i.e., the probability that a trip is completed below a certain threshold time). 2. The variability in travel time for a given trip due to unforeseen causes such as variations in demand or an incident.

Traveler information systems – An integration of technologies that allow the general public to access real-time or near real-time data on traffic factors such as incident conditions, travel time, and speed.

Traveler perception model – A model that estimates the average response or range of responses that travelers would give to a given set of conditions (typically operational or design in nature).

Truck – A heavy vehicle engaged primarily in the transport of goods and materials or in the delivery of services other than public transportation.

Turn lane – See *exclusive turn lane*.

Turnout – A short segment of a lane—usually a widened, unobstructed shoulder area—added to a two-lane, two-way highway, allowing slow-moving vehicles to leave the main roadway and stop so that faster vehicles can pass.

Two-lane highway – A roadway with a two-lane cross section, one lane for each direction of flow, on which passing maneuvers must be made in the opposing lane.

Two-phase pattern – A type of operation at an all-way STOP-controlled intersection where drivers from opposing approaches enter the intersection at roughly the same time.

Two-sided weaving segment – A weaving segment in which at least one weaving maneuver requires three or more lane changes to be completed successfully or in which a single-lane on-ramp is closely followed by a single-lane off-ramp on the opposite side of the freeway.

Two-stage gap acceptance – A condition where a median refuge area is available for minor-street drivers so that drivers sequentially evaluate and use gaps in the near-side major-street traffic stream, followed by gaps in the far-side major-street traffic stream.

Two-way left-turn lane – A lane in the median area that extends continuously along a street or highway and is marked to provide a deceleration and storage area, out of the

through-traffic stream, for vehicles traveling in either direction to use in making left turns at intersections and driveways.

Two-way STOP-controlled – The type of traffic control at an intersection where drivers on the minor street or drivers turning left from the major street wait for a gap in the major-street traffic to complete a maneuver.

Uncertainty – The range within which a model's estimate of a value is statistically likely to vary from the actual value.

Uncontrolled – Lacking a traffic control device that interrupts traffic flow (e.g., a traffic signal, STOP sign, or YIELD sign).

Undersaturated flow – Traffic flow where (a) the arrival flow rate is lower than the capacity of a point or segment, (b) no residual queue remains from a prior breakdown of the facility, and (c) traffic flow is unaffected by downstream conditions.

Uniform delay – The first term of the equation for lane group control delay, assuming constant arrival and departure rates during a given time period.

Uninterrupted flow – Traffic flow on facilities that have no fixed causes of delay or interruption external to the traffic stream; examples include freeways and unsignalized sections of multilane and two-lane rural highways.

Unit extension – See *passage time*.

Unit width flow rate – The pedestrian flow rate expressed as pedestrians per minute per unit of walkway or crosswalk width.

Unmet demand – The number of vehicles on a signalized lane group that have not been served at any point in time as a result of operation in which demand exceeds capacity in either the current or previous analysis period. This does not include the normal cyclical queue formation on the red and discharge on the green phase. See also *initial queue* and *residual queue*.

Unsignalized intersection – An intersection not controlled by traffic signals.

Upstream – The direction from which traffic is flowing.

Urban – An area typified by high densities of development or concentrations of population, drawing people from several areas within a region.

Urban street – A street with relatively high density of driveway access located in an urban area and with traffic signals or interrupting STOP or YIELD signs no farther than 2 mi apart.

Urban street facilities – Extended sections of collector or arterial streets that include the impacts of traffic signals or other traffic control along the street.

Urban street segment – A length of urban street from one boundary intersection to the next, including the upstream boundary intersection but not the downstream boundary intersection.

User perception variability – Variability in user responses that occurs when different users experiencing identical conditions are asked to rate the conditions.

Utility – A measure of the value a traveler places on a trip choice.

Validation – The process by which the analyst checks the overall model-predicted traffic performance for a street-road system against field measurements of traffic performance that were not used in the calibration process.

Variability – The day-to-day variation in other dimensions of congestion within a transportation system.

Vehicle capacity – The maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic, and control conditions.

Vehicle trajectory analysis – The development of performance measures from the properties of time-space trajectories of individual vehicles.

Verification – The process by which a software developer and other researchers check the accuracy of a software implementation of traffic operations theory.

Volume – The total number of vehicles or other roadway users that pass over a given point or section of a lane or roadway during a given time interval, often 1 h.

Volume-to-capacity (v/c) ratio – The ratio of flow rate to capacity for a system element.

Walk interval – A period of time intended to give pedestrians adequate time to perceive the WALK

indication and depart the curb before the pedestrian clear interval begins.

Walkway – See *pedestrian walkway*.

Wave speed – The speed at which a shock wave travels upstream or downstream through traffic.

Weaving – The crossing of two or more traffic streams traveling in the same direction along a significant length of highway, without the aid of traffic control devices (except for guide signs).

Weaving configuration – The organization and continuity of lanes in a weaving segment, which determines lane-changing characteristics.

Weaving flow – The traffic movements in a weaving segment that are engaged in weaving movements.

Weaving length – See *base length*, *maximum weaving length*, and *short length*.

Weaving movement – A traffic flow within a weaving segment (on-ramp to mainline or mainline to off-ramp) that must cross paths with another traffic flow while traversing the segment.

Weaving segment – See *freeway weaving segment*.

Weaving segment influence area – The base length of the weaving segment plus 500 ft upstream of the entry point to the weaving segment and 500 ft downstream of the exit point from the weaving segment; entry and exit points are defined as the points where the appropriate edges of the merging and diverging lanes meet.

Weaving width – The total number of lanes between the entry and exit gore areas within a weaving segment, including the auxiliary lane, if present.

Work zone – A segment of highway in which maintenance or construction operations reduce the number of lanes available to traffic or affect the operational characteristics of traffic flowing through the segment.

Y **Yellow change interval** – The period of time that a yellow indication is displayed to alert drivers to the impending presentation of a red indication.

2. LIST OF SYMBOLS

This section lists and defines the symbols and abbreviations used in the HCM, along with their units if applicable. If a symbol has more than one meaning, the chapter or chapters of the specific use are cited in parentheses after the definition.

$\%HV$	percentage of heavy vehicles (decimal)
$\%OHP$	percentage of segment with occupied on-highway parking
$\%VL_i$	percentage of traffic present in lane L_i
$\%VL_{max}$	percentage of the total approach flow in the lane with the highest volume (decimal)
A	critical flow ratio for the arterial movements
a_1	passenger load weighting factor
$AADT$	annual average daily traffic (veh/day)
A_i	expected passings per minute of mode i by average bicycle
A_p	pedestrian space (ft ² /p)
A_T	expected active passings per minute by the average bicycle during the peak 15 min
ATS_d	average travel speed in the analysis direction (mi/h)
ATS_F	average travel speed for the facility (mi/h)
ATS_i	average travel speed for directional segment i (mi/h)
ATS_{pl}	average travel speed in the analysis segment as affected by a passing lane (mi/h)
AVO_i	average vehicle occupancy on segment i (p/veh)
$b_{d,j}$	destination adjustment factor j
$BFFS$	base free-flow speed (mi/h)
b_i	bunching factor for lane group i
$BLOS$	bicycle level of service score
$b_{o,i}$	origin adjustment factor i
$BPTSF_d$	base percent time-spent-following in the analysis direction
c	base capacity
C	cycle length (s)
$c_{i,PCE}$	capacity for lane i (pc/h)
C'	cycle length (steps)
c_a	adjusted mainline capacity (veh/h)
c_A	average capacity (veh/h)
$c_{a,l,e,p}$	available capacity of an exclusive-lane lane group with protected left-turn operation (veh/h)
c'_a	adjusted capacity of work or construction zone
c_{act}	actual capacity of the flared lane (veh/h)
c_b	capacity of the bicycle lane (bicycles/h)
$c_{bypass,pce}$	capacity of the bypass lane, adjusted for heavy vehicles (pc/h)
c_{dATS}	capacity in the analysis direction under prevailing conditions based on ATS (pc/h)
c_{dPTSF}	capacity in the analysis direction under prevailing conditions based on PTSF (pc/h)

C_e	equilibrium cycle length (s)
$c_{e,L,pce}$	capacity of the left entry lane, adjusted for heavy vehicles (pc/h)
$c_{e,R,pce}$	capacity of the right entry lane, adjusted for heavy vehicles (pc/h)
CG_{DS}	common green time with demand starvation potential (s)
CG_{RD}	common green time between the upstream ramp green and the downstream arterial through green (s)
CG_{UD}	common green time between the upstream through green and downstream through green (s)
ci	set of critical phases on the critical path
c_i	capacity for lane i (veh/h)
c_{IFL}	capacity of a basic freeway segment with the same free-flow speed as the weaving segment under equivalent ideal conditions, per lane (pc/h/ln)
c_{IW}	capacity of all lanes in the weaving segment under ideal conditions (pc/h)
c_{IWL}	capacity of the weaving segment under equivalent ideal conditions (pc/h/ln)
c_l	capacity of a left-turn movement with permitted left-turn operation (veh/h)
$c_{l,e}$	capacity of an exclusive-lane lane group with permitted left-turn operation (veh/h)
$c_{l,e,p}$	capacity of an exclusive-lane lane group with protected left-turn operation (veh/h)
c_{L+TH}	capacity of the through and left-turn movements (veh/h)
$c_{m,j}$	capacity of movement j
$c_{m,x}$	capacity of movement x (veh/h)
$c_{m,y}$	movement capacity of the y movement in the subject shared lane (veh/h)
C_{max}	maximum cycle length (s)
c_{mg}	merge capacity (veh/h)
C_{min}	minimum cycle length (s)
c_{nm}	nonmerge capacity for the inside lane (veh/h)
$c_{p,x}$	potential capacity of movement x (veh/h)
c_{pce}	lane capacity adjusted for heavy vehicles (pc/h)
CP_i	change period (yellow change interval plus red clearance interval) for phase i (s)
$c_{q tr}$	shared lane capacity for upstream right-turn traffic movement (veh/h)
c_R	capacity of the right-turn movement (veh/h)
$c_{r,x}$	capacity of movement x assuming random flow during the unblocked period
c_s	saturated capacity (veh/h)
CS	critical sum (veh/h)
c_{sep}	capacity of the lane if both storage areas were infinitely long (veh/h)
c_{SH}	capacity of the shared lane (veh/h)
c_{sl}	capacity of a shared-lane lane group with permitted left-turn operation (veh/h)
c_{thru}	capacity for the exiting through movement (veh/h)
c_{turn}	capacity for the exiting turn movement (veh/h)
CV	critical phase flow rate (veh/h)
d	demand flow rates (veh/h, Chapter 10); control delay (s/veh, Chapter 17); interchange delay (s/veh, Chapter 22)
D	density (pc/mi/ln, Chapter 14); distance between the two intersections of the interchange (ft, Chapter 22)
d_1	conditional delay to first through vehicle (s/veh)

d_{1b}	baseline uniform delay (s/veh)
d_2	incremental delay (s/veh)
d_3	initial queue delay (s/veh)
d_A	control delay on the approach (s/veh)
d_a	acceleration/deceleration delay (s)
D_a	access-point density on segment (points/mi)
$D_{a,i}$	adjusted volume for destination j (veh/h)
$d_{A,j}$	approach control delay for approach j (s/veh)
$d_{A,x}$	control delay on approach x (s/veh)
d_{ad}	transit vehicle acceleration/deceleration delay due to a transit stop (s/veh)
$d_{ap,i}$	delay due to left and right turns from the street into access point intersection i (s/veh)
$d_{ap,l}$	through vehicle delay due to left turns (s/veh)
$d_{ap,r}$	through vehicle delay due to right turns (s/veh)
$d_{approach}$	control delay for the approach (s/veh)
d_b	bicycle delay (s/bicycle)
D_c	distance to nearest signal-controlled crossing (ft)
D_d	diversion distance (ft)
$DDHV$	directional design-hour volume (veh/h)
D_F	average density for the facility (pc/mi/ln)
d_g	average pedestrian gap delay (s)
d_{gd}	average gap delay for pedestrians who incur nonzero delay
D_i	person-hours of delay on segment i (Chapter 2); density for segment i (pc/mi/ln, Chapter 10)
d_i	vehicle demand on segment i (veh, Chapter 2) ; control delay for lane i (s/veh, Chapter 19)
d_I	intersection control delay (s/veh)
$d_{intersection}$	control delay for the entire intersection (s/veh)
D_j	volume for destination j (veh/h)
d_l	computed control delay for the left-turn movements (s/veh)
$d_{M,LT}$	delay to major left-turning vehicles (s/veh)
D_{MD}	density in the major diverge influence area (which includes all approaching freeway lanes) (pc/mi/ln)
d_{mg}	merge delay (s/veh)
d_{nm}	nonmerge delay for the inside lane (s/veh)
d_{other}	delay due to other sources along the route (s/veh)
D_p	phase duration (s)
d_p	average pedestrian delay (s)
$D_{p,a}$	phase duration for phase a , which occurs just before phase b (s)
$D_{p,b}$	phase duration for phase b , which occurs just after phase a (s)
$d_{p,d}$	pedestrian delay when traversing Crosswalk D (s/p)
$D_{p,l}$	phase duration for left-turn phase l (s)
$D_{p,mi}$	duration of the phase serving the minor-street through movement (s)
$D_{p,t}$	phase duration for coordinated phase t (s)

d_{pc}	pedestrian delay when crossing the segment at a signalized intersection (s/p)
d_{pd}	pedestrian diversion delay (s/p)
D_{ped}	pedestrian density (p/ft ²)
d_{pp}	pedestrian delay when walking parallel to the segment (s/p)
d_{ps}	transit vehicle delay due to serving passengers (s)
d_{pw}	pedestrian waiting delay (s/p)
d_{px}	crossing delay (s/p)
DQ_A	distance to the downstream queue at the beginning of the upstream arterial green (ft)
DQ_i	distance to the downstream queue at the beginning of the upstream green for approach i (ft)
DQ_R	distance to the downstream queue at the beginning of the upstream ramp green (ft)
D_R	density in the ramp influence area (pc/mi/ln)
d_r	computed control delay for the right-turn movements (s/veh)
d_{re}	transit vehicle delay reentering the traffic stream from a transit stop (s/veh)
D_S	speed index for off-ramps
d_s	saturated uniform delay (s/veh)
d_{sep}	control delay for the movement considered as a separate lane
d_{sl}	control delay in shared left-turn and through lane group (s/veh)
d_{sr}	control delay in shared right-turn and through lane group (s/veh)
DSV	daily service volumes
D_{sv}	distance between stored vehicles (= 8 ft)
DSV_i	daily service volume for level of service i (veh/day)
d_t	control delay in exclusive through lane group (s/veh)
$d_{t,1}$	average delay to through vehicles in the inside lane (s/veh)
$d_{t,i}$	total delay associated with interval i (veh-s)
$d_{t l_r}$	through vehicle delay per right-turn maneuver (s/veh)
d_{ts}	delay due to a transit vehicle stop for passenger pickup (s/stop)
D_{up}	unbalanced phase duration (s)
$D_{up,i}$	unbalanced phase duration for phase i (s)
d_{vq}	time-in-queue per vehicle (s/veh)
dx_j	length of discrete segment j (mi)
e	ridership elasticity with respect to changes in the travel time rate (Chapter 17); the extension of effective green time into the clearance interval (s, Chapter 22)
E	weighted events per minute
E_L	equivalent number of through cars for a protected left-turning vehicle
$E_{L,m}$	modified through-car equivalent for a protected left-turning vehicle
E_{L1}	equivalent number of through cars for a permitted left-turning vehicle
$E_{L1,m}$	modified through-car equivalent for a permitted left-turning vehicle
E_{L2}	equivalent number of through cars for a permitted left-turning vehicle when opposed by a queue on a single-lane approach
$E_{L2,m}$	modified through-car equivalent for a permitted left-turning vehicle when opposed by a queue on a single-lane approach
e_p	permitted extension of effective green (s)

E_R	passenger-car equivalent for recreational vehicles (Chapter 10); equivalent number of through cars for a protected right-turning vehicle (Chapter 18)
$E_{R,ap}$	equivalent number of through cars for a protected right-turning vehicle at an access point
$E_{R,m}$	modified through-car equivalent for a protected right-turning vehicle
E_T	passenger-car equivalent for trucks and buses
E_{TC}	passenger-car equivalent for trucks operating at crawl speed
F	total events on the path (events/h)
f_a	adjustment factor for area type (0.90 if CBD, 1.00 otherwise)
f_A	adjustment for access points (mi/h)
f_{ad}	proportion of transit vehicle stop acceleration/deceleration delay not due to traffic control
f_{bb}	adjustment factor for blocking effect of local buses that stop within intersection area
F_{bi}	indicator variable for boundary intersection control type (1.0 if signalized, 0.0 if two-way STOP-controlled)
F_{cd}	roadway crossing difficulty factor
f_{CS}	adjustment for cross section (mi/h)
F_{delay}	pedestrian delay adjustment factor
f_{dt}	proportion of dwell time occurring during effective green
f_F	adjustment for the presence of merge, diverge, and weaving segments along a facility
FFS	free-flow speed (mi/h)
f_g	adjustment factor for approach grade
$f_{g,ATS}$	grade adjustment factor
$f_{g,PTSF}$	grade adjustment factor for PTSF determination
F_h	headway factor
f_{HV}	heavy-vehicle adjustment factor
$f_{HV,ATS}$	heavy-vehicle adjustment factor for average travel speed
$f_{HV,e}$	heavy-vehicle adjustment factor for the lane
$f_{HV,PTSF}$	heavy-vehicle adjustment factor for PTSF determination
f_L	signal spacing adjustment factor
F_l	passenger load factor (passengers/seat)
f_{LC}	adjustment for lateral clearance (mi/h)
f_{Lpb}	pedestrian adjustment factor for left-turn groups
f_{LS}	adjustment for lane and shoulder width (mi/h)
f_{LT}	adjustment factor for left-turn vehicle presence in a lane group
f_{LU}	adjustment factor for lane utilization
f_{LW}	adjustment for lane width (mi/h)
f_M	adjustment for median type (mi/h)
F_m	number of meeting events (events/h)
$f_{np,ATS}$	adjustment factor for ATS determination for the percentage of no-passing zones in the analysis direction
$f_{np,PTSF}$	adjustment to PTSF for the percentage of no-passing zones in the analysis segment
FO_4	force-off point for Phase 4 (s)
f_p	driver population factor

F_p	number of passing events (events/h)
F_p	pavement condition adjustment factor
f_{pb}	pedestrian blockage factor or the proportion of time that one lane on an approach is blocked during 1 h
f_{ped}	entry capacity adjustment factor for pedestrians
$f_{pl,ATS}$	adjustment factor for the effect of passing lane on average travel speed
$f_{pl,PTSF}$	adjustment factor for the impact of a passing lane on percent time-spent-following
f_{Rpb}	pedestrian–bicycle adjustment factor for right-turn groups
f_{RT}	adjustment for right-turning vehicle presence in the lane group
F_S	motorized vehicle speed adjustment factor
f_{sw}	sidewalk width coefficient
f_{TISI}	time-interval scale factor for time period i
F_{tt}	perceived travel time factor
f_v	adjustment factor for traffic pressure
F_v	motorized vehicle volume adjustment factor
f_w	adjustment factor for lane width
F_w	cross-section adjustment factor
g	effective green time (s)
G	percent grade (Chapter 17); green time (s, Chapter 22)
$G_{lped,call}$	average green interval given that the phase is called by a pedestrian detection (s)
$G_{lveh,call}$	average green interval given that the phase is called by a vehicle detection (s)
g'	effective green time adjusted because of the presence of a downstream queue (s)
G_3	green interval duration for Phase 3 (s)
g_a	available effective green time (s)
GA	green interval for the external arterial approach (s)
g_b	effective green time for the bicycle lane (s)
GD	green interval for the downstream arterial through movement (s)
g_{diff}	supplemental service time for shared single-lane approaches (s)
g_e	green extension time (s)
g_f	time before the first left-turning vehicle arrives and blocks the shared lane (s)
$g_{f,max}$	maximum time before the first left-turning vehicle arrives and within which there are sufficient through vehicles to depart at saturation (s)
g_i	effective green time for lane group i (s)
g_l	effective green time for left-turn phase (s)
G_{max}	maximum green setting (s)
G_{min}	minimum green setting (s)
g_p	effective green time for permitted left-turn operation (s)
G_p	displayed green interval corresponding to g_p (s)
$G_{p,min}$	minimum green interval duration based on pedestrian crossing time (s)
g_{ped}	pedestrian service time (s)
$g_{ped,mi}$	pedestrian service time for the phase serving the minor-street through movement (s)
g_{ps}	queue service time during permitted left-turn operation (s)
g_q	opposing queue service time ($= g_s$ for the opposing movement) (s)

G_q	displayed green interval corresponding to g_q (s)
GR	green interval for the left-turning ramp movement (s)
g_s	queue service time (s)
g_u	duration of permitted left-turn green time that is not blocked by an opposing queue (s)
G_u	unbalanced green interval duration for a phase (s)
GU_i	green interval for the upstream approach i (s)
$g_{Walk,mi}$	effective walk time for the phase serving the minor-street movement (s)
h	average headway for each through lane
$h_{ \Delta < h < H_1 }$	average headway of those headways between Δ and H_1 (s/veh)
H_1	maximum headway that the first through vehicle can have and still incur delay (s/veh)
h_{adj}	headway adjustment (s)
h_d	departure headway or average time between departures of successive vehicles on a given approach (s)
$h_{HV,adj}$	headway adjustment for heavy vehicles (s)
h_I	saturation headway for the internal through approach (s)
h_{is}	saturation headway or time between departures of successive vehicles on a given approach for a particular case (case i) (s)
$h_{LT,adj}$	headway adjustment for left turns (s)
h_{other}	full stop rate due to other sources (stops/veh)
$h_{RT,adj}$	headway adjustment for right turns (s)
H_{seg}	spatial stop rate for the segment (stops/mi)
i	crossing event index
I	adjustment factor for type, intensity, and proximity of work activity (pc/h/ln, Chapter 10); upstream filtering adjustment factor (Chapter 18)
$I_{a,seg}$	automobile traveler perception score for segment
$I_{b,int}$	bicyclist perception score for intersection
$I_{b,link}$	bicyclist perception score for link
$I_{b,seg}$	bicyclist perception score for segment
$I_{b,sig}$	bicycle perception score for signalized intersection
ID	interchange density; the number of interchanges within ± 3 mi of the center of the subject weaving segment divided by 6 (int/mi)
I_{LC}	lane-changing intensity; LC_{ALL}/L_S (lc/ft)
$I_{p,int}$	pedestrian perception score for intersection
$I_{p,link}$	pedestrian perception score for link
$I_{p,seg}$	pedestrian perception score for segment
$I_{p,sig}$	pedestrian perception score for signalized intersection
I_{pk}	indicator variable for on-street parking occupancy (= 0 if $p_{pk} > 0.0$)
I_s	interval between vehicle-in-queue counts (s)
I_{sh}	indicator variable for shared lane (= 1.0 if the subject left turn is served in a shared lane; 0 if the subject left turn is served in an exclusive lane)
I_t	indicator variable = 1.0 when equations are used to evaluate delay due to left turns; 0.00001 when equations are used to evaluate delay due to right turns
$I_{t,seg}$	transit passenger perception score for segment

j	time step associated with platoon arrival time t'
k	incremental delay factor
K	proportion of AADT occurring in the peak hour (decimal)
k_i	density of users of mode i (users/mi)
k_{min}	minimum incremental delay factor
L	cycle lost time (s)
l_1	start-up lost time (s)
$l_{1,p}$	permitted start-up lost time (s)
l_2	clearance lost time (s)
L_a	available queue storage distance (ft/ln)
L_A	length of acceleration lane (ft)
$L_{a,comb}$	available queue storage distance for the combined movement (ft/ln)
$L_{a,lt}$	available queue storage distance for the left-turn movement (ft/ln)
$L_{a,thru}$	available queue storage distance for the through movement (ft/ln)
$L_{a,turn}$	available queue storage distance for the turn movement (ft/ln)
L_B	base length of the segment, measured from the points at which the edges of the travel lanes of the merging and diverging roadways converge (ft)
LC_{ALL}	total rate of lane changing of all vehicles within the weaving segment (lc/h)
L_{cc}	curb-to-curb crossing distance (ft)
LC_{FR}	minimum number of lane changes that a freeway-to-ramp weaving vehicle must make to complete the freeway-to-ramp movement successfully
LC_L	left-side lateral clearance (ft)
LC_{MIN}	minimum rate of lane changing that must exist for all weaving vehicles to complete their weaving maneuvers successfully (lc/h)
LC_{NW}	total rate of lane changing by nonweaving vehicles within the weaving segment (lc/h)
LC_R	right-side lateral clearance (ft)
LC_{RF}	minimum number of lane changes that a ramp-to-freeway weaving vehicle must make to complete the ramp-to-freeway movement successfully
LC_{RR}	minimum number of lane changes that must be made by one ramp-to-ramp vehicle to complete a weaving maneuver
LC_W	total rate of lane changing by weaving vehicles within the weaving segment (lc/h)
L_d	length of Crosswalk D (ft)
L_D	length of deceleration lane (ft)
L_{D-A}	lost time on the external arterial approach due to the presence of downstream queue (s)
L_{DOWN}	distance between the subject ramp junction and the adjacent downstream ramp junction (ft)
L_{D-R}	lost time on the external ramp approach due to the presence of downstream queue (s)
L_{DS}	additional lost time due to demand starvation (s)
L_{ds}	length of the stop line detection zone (ft)
$L_{ds,lt}$	length of the stop line detection zone in the left-turn lanes (ft)
$L_{ds,rt}$	length of the stop line detection zone in the right-turn lanes (ft)
$L_{ds,th}$	length of the stop line detection zone in the through lanes (ft)
L_{D-U_i}	lost time on the upstream approach i due to the presence of a downstream queue (s)
L_{EQ}	equilibrium separation distance

L_h	average vehicle spacing in stationary queue (ft/veh)
L_{HV}	stored heavy-vehicle lane length = 45 (ft)
L_i	length of segment i (mi)
L_{pc}	stored passenger car lane length = 25 (ft)
L_{pt}	average passenger trip length (mi)
l_r	length of segment traveled by route ($\leq L$) (ft)
L_s	distance between adjacent signalized intersections (ft)
L_S	short length of the segment, defined as the distance over which lane changing is not prohibited or dissuaded by markings (ft)
L_t	total length of directional segment i (mi)
$l_{t,i}$	phase i lost time (s)
L_{TC}	left-turn flow rate per cycle (veh/cycle)
L_{UP}	distance between the subject ramp junction and the adjacent upstream ramp junction (ft)
L_v	detected length of vehicle (ft)
L_{WI}	influence area of the weaving segment (ft)
L_{wMAX}	maximum length of a weaving segment (ft)
M	pedestrian space (ft ² /p)
M_1	meetings per minute of users already on path segment
MAH	maximum allowable headway (s/veh)
MAH^*	equivalent maximum allowable headway for the phase (s/veh)
MAH_c	maximum allowable headway for the concurrent phase that also ends at the barrier (s/veh)
$MAH_{lt,e}$	maximum allowable headway for permitted left-turning vehicles in exclusive lane (s/veh)
$MAH_{lt,e,p}$	maximum allowable headway for protected left-turning vehicles in exclusive lane (s/veh)
$MAH_{lt,s}$	maximum allowable headway for permitted left-turning vehicles in shared lane (s/veh)
$MAH_{lt,s,p}$	maximum allowable headway for protected left-turning vehicles in shared lane (s/veh)
$MAH_{rt,e,p}$	maximum allowable headway for protected right-turning vehicles in exclusive lane (s/veh)
$MAH_{rt,s}$	maximum allowable headway for permitted right-turning vehicles in shared lane (s/veh)
MAH_{th}	maximum allowable headway for through vehicles (s/veh)
M_{corner}	corner circulation area per pedestrian (ft ² /p)
M_{cw}	crosswalk circulation area per pedestrian (ft ² /p)
m_d	set of all automobile movements that cross Crosswalk D
m_i	average speed of mode i (mi/h)
m_j	number of lane groups on approach j
M_S	speed index for on-ramps (merge areas)
M_T	total number of expected meetings per minute during the peak 15 min
M_y	motorist yield rate (decimal)
n_{15}	count of vehicles during the peak 15-min period (veh)
$n_{15,mj}$	count of vehicles traveling on the major street during a 15-min period (veh/ln)

n_{60}	count of vehicles during a 1-h period (veh)
N_{ap}	number of influential access-point approaches along the segment
$N_{ap,o}$	number of access-point approaches on the right side in the opposing direction of travel (points)
$N_{ap,s}$	number of access-point approaches on the right side in the subject direction of travel (points)
$N_{Arterial}$	number of lanes for the upstream arterial through movement
N_b	bus stopping rate on the subject approach (buses/h)
N_c	total number of pedestrians in the crossing platoon (p)
N_{comb}	number of lanes for the combined movement (ln)
N_d	number of traffic lanes crossed when traversing Crosswalk D (ln)
N_{di}	number of pedestrians arriving at the corner each cycle having crossed the major street (p)
N_{do}	number of pedestrians arriving at the corner each cycle to cross the major street (p)
N_e	number of exclusive lanes in movement group (ln)
N_f	number of fully stopped vehicles (veh/ln)
$N_{f,sl}$	number of fully stopped vehicles in shared left-turn and through lane group (veh/ln)
$N_{f,sr}$	number of fully stopped vehicles in shared right-turn and through lane group (veh/ln)
$N_{f,t}$	number of fully stopped vehicles in exclusive through lane group (veh/ln)
n_g	arrival count during green (veh)
N_g	number of lane groups for which t exceeds 0.0 h
n_i	number of lanes serving phase movement i
N_i	number of lanes in segment i
N_l	number of lanes in exclusive left-turn lane group (ln)
N_{lr}	number of lanes in shared left- and right-turn lane group (ln)
N_{lt}	number of lanes in the left-turn bay (ln)
N_m	parking maneuver rate adjacent to lane group (maneuvers/h)
n_{Max}	length of the storage area such that the approach would operate as separate lanes
N_O	number of outer lanes on the freeway (1 for a six-lane freeway; 2 for an eight-lane freeway)
N_p	spatial distribution of pedestrians (p, Chapter 19); number of partial stops (Chapter 30)
n_{ped}	number of conflicting pedestrians (p/h)
N_{ped}	number of pedestrians crossing during an interval (p)
n_q	maximum number of opposing vehicles that could arrive after g_j and before g_u (veh)
N_{qa}	available queue storage (veh)
$N_{qa,comb}$	available queue storage for the combined movement (veh)
$N_{qx,lt}$	maximum queue storage for the left-turn movement (veh)
$N_{qx,thru}$	maximum queue storage for the through movement (veh)
$N_{qx,turn}$	maximum queue storage for a turn movement (veh)
N_r	number of lanes in exclusive right-turn lane group (ln)
N_{Ramp-L}	number of lanes for the upstream ramp left-turning movement
$N_{rtci,d}$	number of right-turn channelizing islands along Crosswalk D
n_s	number of sneakers per cycle (= 2.0 veh)

N_{sl}	number of lanes in shared left-turn and through lane group (ln)
N_{sr}	number of lanes in shared right-turn and through lane group (ln)
N_t	total number of stops
N_{th}	number of through lanes (shared or exclusive) (ln)
N_{TH}	number of through lanes (shared or exclusive) (ln)
N_{tot}	total number of circulating pedestrians arriving each cycle (p)
N_{tr}	number of transit routes along the subject segment
N_{ts}	average number of transit stops along the subject route (stops)
N_{turn}	number of lanes in the turn bay (ln)
N_{tv}	number of turning vehicles during the walk and pedestrian clear intervals (veh)
N_{WL}	number of lanes from which a weaving maneuver may be completed with one lane change or no lane changes
n_x	number of calls necessary to extend the green to max out
$O_{a,i}$	adjusted volume for origin i (veh/h)
OCC_{bicg}	bicycle occupancy
OCC_{pedu}	pedestrian occupancy after the opposing queue clears
OCC_r	relevant conflict-zone occupancy
O_i	volume for origin i (veh/h)
P	proportion of vehicles arriving during the green indication
p'	adjustment to the major-street left, minor-street through impedance factor
$p_{ap,lt}$	proportion of $N_{ap,o}$ that can be accessed by a left turn from the subject direction of travel
p_b	proportion of time blocked (decimal)
$p_{b,x}$	proportion of time that the subject movement x is blocked by the major-street platoon
P_{BCDEF}	probability that an individual will respond with a score of B, C, D, E, or F
p_{be}	proportion of stops on segment with benches (decimal)
P_{bo}	probability of two blocked lanes in the opposing direction
P_{bs}	probability of two blocked lanes in the subject direction
$p_{building}$	proportion of sidewalk length adjacent to a building face (decimal)
P_c	pavement condition rating
PC	pedestrian clear setting (s)
P_{CDEF}	probability that an individual will respond with a score of C, D, E, or F
p_{curb}	proportion of segment with curb on the right-hand side (decimal)
P_{DEF}	probability that an individual will respond with a score of D, E, or F
P_{do}	probability of delayed passing in opposing direction
P_{ds}	probability of delayed passing in subject direction
P_{EF}	probability that an individual will respond with a score of E or F
P_F	probability that an individual will respond with a score of F
P_{FD}	proportion of diverging traffic remaining in Lanes 1 and 2 immediately upstream of the deceleration lane
p_{fence}	proportion of sidewalk length adjacent to a fence or low wall (decimal)
P_{FM}	proportion of freeway vehicles remaining in Lanes 1 and 2 immediately upstream of the on-ramp influence area
PHF	peak hour factor

P_{HV}	percentage of heavy vehicles in the corresponding movement group (%)
P_{HVa}	adjusted percentage of heavy vehicles in the midsegment demand flow rate (%)
p_i	path mode split for user group i
p_{ij}	seed proportion of volume from origin i to destination j (decimal)
p_j	distance required to pass mode i (mi)
P_L	proportion of left-turning vehicles in the shared lane
P_{lc}	probability of a lane change among the approach through lanes
P_{lt}	proportion of left-turning vehicles on the subject approach (decimal)
P_{LT}	proportion of left-turning vehicles in the lane
$P_{LTL,seg}$	proportion of intersections with left-turn lanes (or bay) on segment (decimal)
P_{lto}	proportion of left-turning vehicles in the opposing traffic stream
P_{mds}	probability of delayed passing for mode m
P_{no}	probability of blocked lane in opposing direction
P_{ns}	probability of blocked lane in subject direction
p_{ot}	proportion of transit vehicles arriving on time (decimal)
p_{ov}	probability of left-turn bay overflow (decimal)
p_{pk}	proportion of on-street parking occupied (decimal)
P_R	proportion of recreational vehicles in the traffic stream (Chapter 10); proportion of right-turning vehicles in the shared lane (Chapter 30)
p_{rm}	proportion of link length with restrictive median (decimal)
P_{rt}	proportion of right-turning vehicles on the subject approach (decimal)
P_{RT}	proportion of right-turning vehicles in the lane
p_{sh}	proportion of stops on segment with shelters (decimal)
P_T	proportion of trucks and buses in the traffic stream
PT	passage time setting (s)
P_{TC}	proportion of trucks operating at crawl speed (decimal)
P_{Tds}	total probability of delayed passing
PT_{lt}	passage time setting for phase serving left-turning vehicles (s)
PT_{rt}	passage time setting for phase serving right-turning vehicles (s)
$PTSF_d$	percent time-spent-following in the analysis direction (decimal)
$PTSF_F$	percent time-spent-following for the facility (decimal)
$PTSF_i$	percent time-spent-following for segment i (decimal)
$PTSF_{pl}$	percent time-spent-following for segment as affected by the presence of a passing lane (decimal)
PT_{th}	passage time setting for phase serving through vehicles (s)
P_{turn}	proportion of turning vehicles in the shared lane = P_L or P_R (decimal)
P_{window}	proportion of sidewalk length adjacent to a window display (decimal)
p_x	probability of phase termination by extension to the maximum green limit
q	arrival flow rate = $v/3,600$ (veh/s)
Q	back-of-queue size (veh/ln)
q^*	arrival flow rate for the phase (veh/s)
$q'_{a u,j}$	arrival flow rate in time step j at a downstream intersection from upstream source u (veh/step)
$q'_{u,i}$	departure flow rate in time step i at upstream source u (veh/step)

Q_1	first-term back-of-queue size (veh/ln)
Q_2	second-term back-of-queue size (veh/ln)
$Q_{2,sl}$	second-term back-of-queue size for shared left-turn and through lane group (veh/ln)
$Q_{2,sr}$	second-term back-of-queue size for shared right-turn and through lane group (veh/ln)
$Q_{2,t}$	second-term back-of-queue size for exclusive through lane group (veh/ln)
Q_{2+3}	back-of-queue size (veh/ln)
Q_3	third-term back-of-queue size (veh/ln)
$Q_{3,sl}$	third-term back-of-queue size for shared left-turn and through lane group (veh/ln)
$Q_{3,sr}$	third-term back-of-queue size for shared right-turn and through lane group (veh/ln)
$Q_{3,t}$	third-term back-of-queue size for exclusive through lane group (veh/ln)
Q_{95}	95th percentile queue (veh)
Q_A	estimated average per lane queue length for the through movement in the downstream (internal) link at the beginning of upstream arterial Phase A (ft)
Q_b	initial queue at the start of the analysis period (veh)
$Q_{b,comb}$	initial queue for the combined movement (veh)
q_d	arrival flow rate for downstream lane group (veh/s)
Q_e	queue at the end of the analysis period (veh)
Q_{eo}	queue at the end of the analysis period when $v \geq c_A$ and $Q_b = 0.0$ (veh)
Q_f	queue size at the end of g_f (veh)
q_g	arrival flow rate during the effective green time (veh/s)
q_i	hourly directional path flow rate for user group i (modal users/h)
Q_i	queue size at the end of interval i (veh)
$Q_{INITIAL}$	length of the queue stored at the internal approach at the beginning of the interval during which this approach has demand starvation potential
q_n	outside lane flow rate = $v_n/3,600$ (veh/s)
Q_{ob}	bicycle demand in the opposing direction (bicycles/h)
Q_p	queue size at the end of permitted service time (veh)
Q_p'	queue size at the end of permitted service time, adjusted for sneakers (veh)
Q_q	queue size at the start of g_u (veh)
q_r	arrival flow rate during the effective red time (veh/s)
Q_r	queue size at the end of effective red time ($= q_r, r$) (veh)
Q_R	estimated average per lane queue length for the through movement in the downstream (internal) link at the beginning of upstream ramp Phase R (ft)
Q_{sb}	bicycle demand in the same direction (bicycles/h)
Q_{sep}	average queue length for the movement considered as a separate lane (veh)
Q_T	total hourly directional path demand (modal users/h)
Q_{ido}	total time spent by pedestrians waiting to cross the major street during one cycle (p-s)
r	effective red time ($= C - g$) (s)
R	manual adjustment for on-ramps (veh/h, Chapter 10); radius of corner curb (Chapter 18); critical flow ratio for the exit-ramp movements (Chapter 22)
R, b, c	intermediate calculation variables
r_a	acceleration rate = 3.5 (ft/s ²)
r_{at}	transit vehicle acceleration rate (ft/s ²)
R_c	red clearance interval (s)

$R_{c,mi}$	red clearance interval of the phase serving the minor-street through movement (s)
r_d	deceleration rate
r_{dt}	transit vehicle deceleration rate (ft/s ²)
R_p	platoon ratio
R_Q	queue storage ratio
r_{qg}	queue growth rate (veh/h)
RS	reference sum flow rate ($1,530 \times PHF \times f_a$) (veh/h)
RW	reciprocal of path width = 1/path width (ft)
s	saturation flow rate (veh/h, Chapter 4); mean service rate (veh/h, Chapter 4); standard deviation of the set of runs for a particular performance measure (Chapter 7); adjusted saturation flow rate (veh/h/ln, Chapter 17)
S	average travel speed (mi/h)
s_0	base saturation flow rate (veh/hg/ln)
S_0	speed constant (mi/h)
S_{0i}	free-flow speed of segment i (mi/h)
s_1	saturation flow rate for the inside lane (veh/h/ln)
$S_{85,mj}$	85th percentile speed at a midsegment location on the major street (mi/h)
S_a	average speed on the intersection approach (mi/h)
S_b	bicycle running speed (mi/h)
SF	service flow rates
S_f	free-flow speed (mi/h)
S_F	free-flow speed of the ramp at the junction point (mi/h)
SF_i	service flow rate for LOS i (veh/h)
SFI_i	service flow rate under ideal conditions (pc/h)
S_{FM}	mean speed of sample ($v > 200$ veh/h) (mi/h)
S_{fo}	base free-flow speed (mi/h)
S_{FR}	free-flow speed of the ramp (mi/h)
S_i	average vehicle speed on segment i (mi/h)
s_i	saturation flow rate for phase movement i (veh/hg/ln)
s_l	saturation flow rate in exclusive left-turn lane group with permitted operation (veh/h/ln)
s_{lc}	maximum flow rate in which a lane change can occur = $3,600/t_{lc}$ (veh/h/ln)
s_{lr}	saturation flow rate in shared left- and right-turn lane group (veh/h/ln)
s_{lt}	saturation flow of an exclusive left-turn lane with protected operation (veh/h/ln)
S_{MAX}	maximum average speed of weaving vehicles expected in a weaving segment (mi/h)
S_{MIN}	minimum average speed of weaving vehicles expected in a weaving segment (mi/h)
S_{NW}	average speed of nonweaving vehicles within the weaving segment (mi/h)
s_o	base saturation flow rate (pc/h/ln)
S_O	average speed of vehicles in outer lanes of the freeway, adjacent to the 1,500-ft ramp influence area (mi/h)
$S_{o,local}$	local base saturation flow rate (pc/h/ln)
s_p	saturation flow rate of a permitted left-turn movement (veh/h/ln)
S_p	posted speed limit (mi/h, Chapter 15); pedestrian walking speed = 3.5 ft/s (Chapter 30)

S_{ped}	pedestrian speed (ft/min)
S_{pf}	free-flow pedestrian walking speed (ft/s)
S_{pl}	posted speed limit (mi/h)
$S_{prevailing,i}$	prevailing saturation flow rate for lane group i (veh/h/ln)
$s_{q l_r}$	shared lane discharge flow rate for upstream right-turn traffic movement (veh/h/ln)
s_r	saturation flow rate in exclusive right-turn lane group with permitted operation (veh/h/ln)
S_R	average speed in the ramp influence area (mi/h)
S_{Ra}	adjusted motorized vehicle running speed (mi/h)
S_{Rt}	transit vehicle running speed (mi/h)
S_s	threshold speed defining a stopped vehicle (= 5.0 mi/h)
s_{sl}	saturation flow rate in shared left-turn and through lane group with permitted operation (veh/h/ln)
$s_{sl,min}$	minimum saturation flow rate in shared left-turn and through lane group with permitted operation (veh/h/ln)
s_{sl2}	saturation flow rate in shared left-turn and through lane group during Period 2 (veh/h/ln)
S_{spot}	average spot speed (mi/h)
s_{sr}	saturation flow rate in shared right-turn and through lane group with permitted operation (veh/h/ln)
s_t	saturation flow rate in exclusive through lane group (veh/h/ln)
S_t	effective speed factor
$S_{T,seg}$	travel speed of through vehicles for the segment (mi/h)
$S_{Tb,seg}$	travel speed of through bicycles along the segment (mi/h)
s_{th}	saturation flow rate of an exclusive through lane (= base saturation flow rate adjusted for lane width, heavy vehicles, grade, parking, buses, and area type) (veh/h/ln)
$S_{Tp,seg}$	travel speed of through pedestrians for the segment (ft/s)
$S_{Tt,seg}$	travel speed of transit vehicles along the segment (mi/h)
SV_i	service volume for LOS i (veh/h)
S_W	average speed of weaving vehicles within the weaving segment (mi/h)
s_{w-r}	transit wait-ride score
t	duration of unmet demand in the analysis period (h, Chapter 18); path segment travel time for average bicycle (min, Chapter 23)
T	analysis time period
t'	platoon arrival time (steps)
t'_p	blocked period duration (steps)
t'_R	segment running time (steps)
T_0	time at which a vehicle would have arrived at the stop line if it had been traveling at the reference speed
T_1	time at which a vehicle would have arrived at the stop line if it had been traveling at the "running" speed
T_2	time at which a vehicle is discharged at the stop line
$t_{3,LT}$	adjustment factor for intersection geometry
t_a	average duration of unmet demand in the analysis period (h)
t_A	adjusted duration of unmet demand in the analysis period (h)
T_{at}	amenity time rate (min/mi)

T_{btt}	base travel time rate = 6.0 for the central business district of a metropolitan area with 5 million persons or more, otherwise 4.0 (min/mi)
T_c	time until spillback (h)
t_c	queue clearing time (Chapter 18); critical headway for a single pedestrian (s, Chapter 19)
$t_{c,base}$	base critical headway (s)
$t_{c,G}$	adjustment factor for grade (s)
$t_{c,HV}$	adjustment factor for heavy vehicles (s)
$t_{c,x}$	critical headway (i.e., the minimum time that allows intersection entry for one minor-stream vehicle) for minor movement x (s)
t_{cg}	critical gap (s)
t_{cl}	clearance time of the right-turn vehicle (s)
t_d	dwelt time (s)
$t_{d,i}$	duration of time interval i during which the arrival flow rate and saturation flow rate are constant (s)
t_{ex}	excess wait time due to late arrivals (s)
T_{ex}	excess wait time rate due to late arrivals (min/mi)
t_f	follow-up headway (s, Chapter 21); service time for fully stopped vehicles (s, Chapter 30)
$t_{f,base}$	base follow-up headway (s)
$t_{f,HV}$	adjustment factor for heavy vehicles (0.9 for major streets with one lane in each direction, 1.0 for major streets with two or three lanes in each direction)
$t_{f,x}$	follow-up headway (i.e., the time between the departure of one vehicle from the minor street and the departure of the next vehicle under a continuous queue condition) for minor movement x (s)
t_{ft}	follow-up headway (s)
t_i	lost time for i th vehicle in queue (s, Chapter 4); duration of unmet demand for lane group i in the analysis period (h, Chapter 18)
t_l	transit vehicle running time loss (min/mi)
t_L	lost time per phase (s)
t_L'	adjusted lost time (i.e., the time during which the signalized intersection is not used effectively by any movement) (s)
t_L''	adjusted lost time for the internal approaches (s)
t_{late}	threshold late time = 5.0 typical (min)
t_{lc}	critical merge headway = 3.7 (s)
T_{LC}	total lateral clearance (ft)
T_{occ}	crosswalk occupancy time (p-s)
T_p	analysis time period
t_{pr}	pedestrian perception of signal indication and curb departure time (= 7.0 s)
t_{ps}	pedestrian service time (s)
T_{ptt}	perceived travel time rate (min/mi)
t_Q	time duration of queue (s)
t_R	segment running time (s)
t_{Rb}	segment running time of through bicycles (s)
T_{RD}	total ramp density (ramps/mi)
t_{Rt}	segment running time of transit vehicle (s)

t_s	pedestrian start-up time and end clearance time (s, Chapter 19); service time or average time spent by a vehicle in first position waiting to depart (s, Chapter 20)
TS_c	time-space available for circulating pedestrians (ft ² -s)
TS_{corner}	available corner time-space (ft ² -s)
TS_{cw}	available crosswalk time-space (ft ² -s)
TS_{cw}^*	effective available crosswalk time-space (ft ² -s)
TS_{tv}	time-space occupied by turning vehicles (ft ² -s)
$t_{t,i}$	duration of trapezoid or triangle in interval i (s)
TT_i	total travel time of all vehicles in segment i (veh-h)
TT_{i15}	total travel time consumed by all vehicles traversing directional segment i during the 15-min analysis period (veh-h)
U	speed of average bicycle (mi/h)
u_m	minimum speed of the first through vehicle given that it is delayed (ft/s)
u_{rt}	right-turn speed (ft/s)
v	actual flow rates
V	demand volume under prevailing conditions (veh/h)
v_1	flow rate for the inside lane (veh/h/ln)
v_{12}	demand flow rate in Lanes 1 and 2 of the freeway immediately upstream of the ramp influence area (pc/h)
v_{15}	pedestrian flow rate during the peak 15 min (p/h)
V_{15}	volume during the peak 15 min of the analysis hour (veh/15 min)
v_2	flow rate in the adjacent through lane (veh/h/ln)
v_3	flow rate in Lane 3 of the freeway (pc/h/ln)
$v_{a,1}$	adjusted arrival volume in the shared lane (veh/h)
$v_{a,b}$	flow rate of pedestrians traveling through the corner from Sidewalk A to Sidewalk B, or vice versa (p/h)
$v_{A,x}$	volume or flow rate on approach x (veh/h)
v_a/N_A	arterial flow feeding the subject queue, divided by the respective number of lanes
v_{app}	average demand flow rate per through lane (upstream of any turn bays on the approach) (veh/h/ln)
$v_{Arterial}$	upstream arterial through flow (v/h)
v_{bic}	bicycle flow rate (bicycles/h)
v_{bicg}	bicycle flow rate during the green indication (bicycles/h)
v_c	conflicting flow rate
$v_{c,min}$	minimum platooned flow rate (veh/h), assumed to be $1,000N$, where N is the number of through lanes per direction on the major street
$v_{c,pce}$	conflicting flow rate (pc/h)
$v_{c,u,x}$	conflicting flow for movement x during the unblocked period (veh/h)
$v_{c,x}$	conflicting flow rate for movement x (veh/h)
v_{ci}	flow rate of pedestrians arriving at the corner after crossing the minor street (p/h)
v_{co}	flow rate of pedestrians arriving at the corner to cross the minor street (p/h)
v_D	flow rate on the adjacent downstream ramp (pc/h)
$v_{d,ATS}$	demand flow rate for ATS determination in the analysis direction (pc/h)
$v_{d,PTSF}$	demand flow rate in the analysis direction for estimation of PTSF (pc/h)

v_{di}	flow rate of pedestrians arriving at the corner after crossing the major street (p/h)
v_{do}	flow rate of pedestrians arriving at the corner to cross the major street (p/h)
$V_{dOFF15ij}$	adjusted 15-min exit demand for time period i and exiting location j (veh)
v_e	entry flow rate
v_{ex}	exit flow rate
$v_{ex,pce}$	conflicting exiting flow rate (pc/h)
v_F	flow rate on freeway immediately upstream of the ramp influence area under study (pc/h)
v_{FF}	freeway-to-freeway demand flow rate in the weaving segment (pc/h)
v_{FO}	flow rate on the freeway immediately downstream of the merge or diverge area (pc/h)
v_{FR}	freeway-to-ramp demand flow rate in the weaving segment (pc/h)
v_g	demand flow rate for movement group (veh/h)
v_{g1}	demand flow rate in the single exclusive lane with the highest flow rate of all exclusive lanes in movement group (veh/h/ln)
v_h	pedestrian demand during the analysis hour (p/h)
v_i	demand flow rate for movement i (pc/h, Chapter 19); phase movement volume for phase i (veh/h, Chapter 22)
V_i	demand volume for movement i (veh/h, Chapter 19); speed of path user of mode i (mi/h, Chapter 23)
v_i'	demand flow rate (veh/cycle/ln)
$v_{i,1}$	major-street through vehicles in shared lane (veh/h)
$v_{i,2}$	major-street turning vehicles in shared lane (veh/h)
$v_{i,ATS}$	demand flow rate i for ATS estimation (pc/h)
v_{ij}	volume entering from origin i and exiting at destination j (veh/h)
$v_{i,pce}$	demand flow rate for movement i (pc/h)
$v_{i,PTSF}$	demand flow rate i for determination of PTSF (pc/h)
v_j	flow rate of movement j
v_l	demand flow rate in exclusive left-turn lane group (veh/h/ln)
v_L	major left-turn/U-turn flow rate (veh/h)
v_{L+TH}	through and left-turn volume (veh/h)
v_{lr}	demand flow rate in shared left- and right-turn lane group (veh/h)
v_{lt}	left-turn demand flow rate (veh/h)
$v_{lt,perm}$	permitted left-turn demand flow rate (veh/h)
v_m	midsegment demand flow rate (direction nearest to the subject sidewalk) (veh/h)
v_{ma}	adjusted midsegment demand flow rate (veh/h)
v_{mg}	merge flow rate (veh/h/ln)
VMT_i	vehicle miles traveled for segment i (veh-mi)
VMT_{i15}	total vehicle miles traveled by all vehicles in directional segment i during the 15-min analysis period (veh-mi)
v_n	flow rate for the outside lane (veh/h/ln)
v_{NW}	nonweaving demand flow rate in the weaving segment (pc/h)
v_o	opposing demand flow rate (veh/h)
$v_{o,ATS}$	demand flow rate for ATS determination in the opposing direction (pc/h)
$v_{o,PTSF}$	demand flow rate in the opposing direction for estimation of PTSF (pc/h)

v_{OA}	average per lane demand flow in outer lanes adjacent to the ramp influence area (not including flow in Lanes 1 and 2) (pc/h/ln)
$V_{OFF15ij}$	15-min exit count for time period i and exiting location j (veh)
v_{OL}	directional demand flow rate in the outside lane (veh/h)
V_{ON15ij}	15-min entering count for time period i and entering location j (veh)
v_p	demand flow rate under equivalent base conditions (pc/h/ln, Chapter 11); pedestrian flow per unit width (p/ft/min, Chapter 17)
v_{ped}	pedestrian flow rate (p/min/ft)
$v_{ped,i}$	pedestrian flow rate in the subject crossing for travel direction i (p/h)
v_{pedg}	pedestrian flow rate during the pedestrian service time (p/h)
v_R	flow rate on the on-ramp or off-ramp (pc/h, Chapter 13); right-turn volume (veh/h, Chapter 19)
VR	volume ratio
v_R/N_R	ramp flow that feeds the subject queue, divided by the respective number of lanes
v_{R12}	sum of the flow rates in Lanes 1 and 2 and the ramp flow rate (on-ramps only) (pc/h)
v_{Ramp-L}	upstream ramp left-turning flow (v/h)
v_{RF}	ramp-to-freeway demand flow rate in the weaving segment (pc/h)
v_{RR}	ramp-to-ramp demand flow rate in the weaving segment (pc/h)
v_{rt}	right-turn demand flow rate (veh/h)
v_{rtor}	right-turn-on-red flow rate (veh/h)
v_s	transit frequency for the segment (veh/h)
v_{sep}	flow rate for the movement (veh/h)
v_{sl}	demand flow rate in shared left-turn and through lane group (veh/h)
$v_{sl,lt}$	left-turn flow rate in shared lane group (veh/h/ln)
v_{sr}	demand flow rate in shared right-turn and through lane group (veh/h)
$v_{sr,rt}$	right-turn flow rate in shared lane group (veh/h/ln)
v_t	demand flow rate in exclusive through lane group (veh/h/ln, Chapter 17); transit vehicle flow rate in pattern = $\sum v_i$ (veh/h, Chapter 17)
v_{th}	through demand flow rate (veh/h)
V_{tot}	total number of vehicles arriving during the survey period (veh)
v_U	flow rate on the adjacent upstream ramp (pc/h)
v_W	weaving demand flow rate in the weaving segment (pc/h)
v_x	flow rate for movement x (veh/h)
v_y	flow rate of the y movement in the subject shared lane (veh/h)
w	lane width of the lane that the minor movement is negotiating into (ft)
W	weaving intensity factor (Chapter 12); effective width of crosswalk (ft, Chapter 30)
W_1	effective width of combined bicycle lane and shoulder (ft)
W_a	effective width of Sidewalk A (ft)
W_A	available sidewalk width (ft)
W_{aA}	adjusted available sidewalk width (ft)
$Walk$	pedestrian walk setting (s)
W_b	effective width of Sidewalk B (ft)
W_{bl}	width of the bicycle lane (ft)
W_{buf}	buffer width between roadway and available sidewalk (ft)

W_{cd}	curb-to-curb width of the cross street (ft)
W_d	effective width of Crosswalk D (ft)
W_e	average effective width of the outside through lane (ft)
W_E	effective crosswalk width (ft)
W_i	width of signalized intersection as measured along the segment centerline (ft)
W_O	sum of fixed-object effective widths and linear-feature shy distances at a given point along the walkway (ft)
$W_{O,i}$	adjusted fixed-object effective width on inside of sidewalk (ft)
$W_{O,o}$	adjusted fixed-object effective width on outside of sidewalk (ft)
W_{ol}	width of the outside through lane (ft)
W_{OL}	outside lane width (ft)
W_{os}	width of paved outside shoulder (ft)
w_q	queue change rate (veh/s)
W_s	paved shoulder width (ft)
$W_{s,i}$	shy distance on inside of sidewalk (ft)
$W_{s,o}$	shy distance on outside of sidewalk (ft)
W_t	total width of the outside through lane, bicycle lane, and paved shoulder (ft)
W_T	total walkway width at a given point along the walkway (ft)
W_v	effective width as a function of traffic volume (ft)
x	degree of utilization
X	volume-to-capacity ratio
X_1	volume-to-capacity ratio in the shared lane
X_A	average volume-to-capacity ratio
X_c	critical intersection volume-to-capacity ratio
X_i	volume-to-capacity ratio for lane group i
X_u	weighted volume-to-capacity ratio for all upstream movements contributing to the volume in the subject movement group
Y	yellow-plus-all-red change-and-clearance interval (s)
Y_c	sum of the critical flow ratios
$y_{c,i}$	critical flow ratio for phase i
Y_{mi}	change interval of the phase serving the minor-street through movement (s)
YP_2	yield point for Phase 2 (s)
y_t	effective flow ratio for the concurrent phase when dictated by travel time
Δ	headway of bunched vehicle stream (s/veh)
Δ^*	equivalent headway of bunched vehicle stream served by the phase (s/veh)
Δ_i	headway of bunched vehicle stream in lane group i (s/veh)
λ	flow rate parameter (veh/s)
λ^*	flow rate parameter for the phase (veh/s)
$\lambda_{c,i}$	flow rate parameter for lane group i served in the concurrent phase that also ends at the barrier (veh/s)
λ_i	flow rate parameter for lane group i
λ_l	flow rate parameter for the exclusive left-turn lane group (veh/s)
λ_r	flow rate parameter for the exclusive right-turn lane group (veh/s)
λ_{sl}	flow rate parameter for shared left-turn and through lane group (veh/s)

λ_{sr}	flow rate parameter for shared right-turn and through lane group (veh/s)
λ_t	flow rate parameter for exclusive through lane group (veh/s)
σ_{spot}	standard deviation of spot speeds (mi/h)
ΣV_{iq}	sum of vehicle-in-queue counts (veh)
φ^*	combined proportion of free (unbunched) vehicles for the phase
φ_i	proportion of free (unbunched) vehicles in lane group i

